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NOTES

ON THE

NILE VALLEY AND MALTA.

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NOTES OF A NATURALIST

IN THE

NILE VALLEY AND MALTA

A NARRATIVE OF EXPLORATION AND RESEARCH IN CONNECTION WITH THE NATURAL HISTORY, GEOLOGY, AND ARCHÆOLOGY OF THE LOWER NILE AND MALTESE ISLANDS.

BY ANDREW LEITH ADAMS, M.B.

AUTHOR OF "WANDERINGS OF A NATURALIST IN INDIA."

39775

Denizens of the Egyptian Palm Groves.

EDINBURGH: EDMONSTON AND DOUGLAS.

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DEDICATED

TO

MAJOR-GENERAL THE RIGHT HONOURABLE

SIR HENRY K. STORKS, G.C.B. AND G.C.M.G., ETC.

LATE GOVERNOR AND COMMANDER-IN-CHIEF

OF THE

MALTESE ISLANDS,

IN TOKEN OF THE ENLIGHTENED COUNTENANCE EXTENDED BY HIM TOWARDS THE RESEARCHES OF THE AUTHOR.

PREFACE.

THE following contributions to the natural history and archæology of the Lower Nile and Malta, are the productions of my leisure hours and vacation rambles while on service with the 22d Regiment in the last-named island. To perhaps a few of my readers these *horæ subsecivæ* will appear to have been exceedingly frequent, to have thus enabled me to carry out the extended and somewhat arduous researches and explorations here recorded; or, in other words, that the duties of an army-surgeon can be neither very onerous nor engrossing. Now, for the most part, this is true as regards salubrious climates, and in the absence of war and pestilence, just as much as the contrary is true in troubled times and in unhealthy countries; but more especially in "this weak piping time of peace" there is a considerable amount of daily freedom from occupation established by military routine, and which admits of being wasted or utilized according to the individual's mental or bodily constitution. I cannot, however, thus briefly refer to the conditions under which the contents of this volume were obtained, without entering my humble protest against the small-minded belief which declares that a professional man, more especially a member of the healing art, in order to

attain success in practice, preference or advancement, should have no leisure to devote to the cultivation of any pursuit, literary or scientific, beyond his immediate calling. I am well aware that such doctrines can have no advocates among the liberally educated portion of the profession or public generally; while, unquestionably, there are many who would take no exception to one's leisure hours being spent in idleness or in pursuit of pleasure.

To individuals given to this mode of computing the business excellence of others, I desire to apologize for having spent a certain portion of my leisure time in the cultivation of the natural sciences; at the same time reminding them of the memorable words of Cicero, when offering an excuse for having devoted an occasional leisure hour to the study of elegant literature—words pertinent to these remarks, as they are hallowed to me from other associations than any referring to my own insignificant labours,—"Quare quis tandem me reprehendat, aut quis mihi jure succenseat, si, quantum ceteris ad suas res obeundas, quantum ad festos dies ludorum celebrandos, quantum ad alias voluptates, et ad ipsam requiem animi et corporis conceditur temporum; quantum alii tribuunt tempestivis conviviis; quantum denique aleæ, quantum pilæ; tantum mihi egomet ad hæc studia recolenda sumsero."[1] It must nevertheless be admitted that there is a Scylla and Charybdis to steer between, which, it is earnestly hoped, has been the course pursued by the author of the following contributions —devoted chiefly to a consideration of objects in connection

[1] *Pro Archia Poeta.*

with a science, a well-grounded knowledge of which he believes advantageous to all who desire to attain to respectable acquirements in the profession to which he belongs. In conclusion, whatever may be the views of others, it has always appeared to him that an acquaintance with the principles of comparative anatomy, zoology, botany, descriptive, physiographic, and dynamical geology, is especially requisite for the army-surgeon, whose duties in all climes, and under constantly varying conditions, place him frequently in important positions, where he will find his information on these subjects not only of vast advantage to himself, but most beneficial towards the well-being of those on whom he exercises his sanative knowledge.

CORK, *May* 1870.

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ERRATA.

Page 7, line 18, *for* black-winged, *read* black-headed.
,, 47, line 22, *for* crocuta, *read* brunnea.
,, 50, note, *for* which seems to be the same as one, *read* seems to be distinct from that.
,, 52, line 3, *read* opposite to those of their.
,, 109, line 7, *for* white-winged, *read* white-tailed.
,, 139, line 21, *for* page 74, *read* page 96.
,, 140, line 3, *for* frequent, *read* serrated.
,, 145, line 7, *for* fine, *read* firm.
,, 150, line 6, *for* Plate, *read* figs. 2 and 3, page 160.
,, 155, line 3, *for* comprised, *read* composed.
,, 162, line 2 from foot, *for* plaits, *read* plates.
,, 163, line 4, *for* due, *read* rock.
,, 163, note 1, *read* See Note 2, p. 220, and Plate II. fig. 1.

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INTRODUCTORY.

THE heterogeneous materials contained in the following chapters, and their disjointed arrangement, require that I should briefly state the circumstances under which they were obtained. It is needless to remark that any account of the local scenery or monuments of Egypt would be only a repetition of what has been recorded by hundreds of competent travellers. I have therefore selected the chief natural objects of interest, and such as appear to me still deserving of further research. The following notes were collated from observations made during three months' sojourn on the Nile between Alexandria and the second cataract in Nubia. On the occasion I had the rare good fortune to find in my companion one who had not only visited the scenes on which I was about to enter, but enjoyed a well-earned reputation for his intimate acquaintance with the local scenery and antiquities. We left Malta together in October 1862, arranging beforehand the following programme of our intended researches. My companion, Mr. A. H. Rhind, F.S.A., proposed to confine his labours solely to the elucidation of the historical levels of the Nile, as shown by the monuments on its banks, whilst I resolved to search for evidences of upheaval or depression of the country, with the view of adding to the testimonies of geologists in connexion with the Sahara Desert, as demonstrated by Ritter, Desor, Tristram,

and others,[1] and thus try to complete the chain of evidence which purports that Northern Africa was elevated above the sea since the Glacial epoch of geologists. I had, moreover, other ends in view. Apart from a general survey of the animals of the two regions, it occurred to me, with an accomplished Egyptologist for a guide, that by instituting a careful comparison between the natural objects depicted in the hieroglyphic writings and sculptures with the present denizens of the country, I might be enabled to identify the familiar objects of 5000 years ago with those now inhabiting the country, and note their numerical and physical distinctions. The results of my own observations I shall now attempt to lay before the reader. The death of Mr. Rhind shortly after our return put a stop to the preconcerted arrangement between us of a conjoined publication of our labours—to me a subject of much regret, for, apart from the loss of a tried and much respected friend, I had looked forward to a combination of the results of our humble efforts with no small degree of pleasure. I will say, however, in justice to the memory of my fellow-worker, that it has been no fault of mine that his valuable notes made on the above occasion have not been utilized for the benefit of Science.[2] To the tourist in search of health or pleasure, the Nile Valley, from

[1] Lyell's *Elements*, 6th edition, p. 175.

[2] To show what an ardent student may accomplish, Mr. Rhind, although in very delicate health, conducted soundings from the Delta to the second cataract and back, besides measurements and surveys about the temples and on the river's banks, an undertaking requiring great bodily exertion, which was in his case supported by an ardour in the pursuit of science scarcely equalled by its most enthusiastic devotees. Mr. Rhind's notes passed into unknown hands at his death, and have not, to the best of my knowledge, been published, or even any attempts made to edit them. I regret this much, being fully aware of their accuracy and high scientific value.

the sea at all events to the second cataract, will be found to present an admirable field for study, more especially to him whose tastes soar above the mere gratification of sight-seeing. The painter and antiquarian of course are provided for, the naturalist may find ample scope for his researches; whilst, if all make their entrances in October, or during the following six months, they will enjoy a climate second to none on the face of the earth. Contrariwise, let not the indolent go up the Nile, either on the score of health or pleasure; and this leads me to record a few observations with reference to the valetudinarian, of all others the most numerous class of European Nile voyagers.

Advice to the Invalid.—In the first place, I can assure the invalid who has no intellectual tastes or resources within himself, that he will feel the Nile-boat life a most monotonous one; but if he can combine amusement and instruction he need seldom know a dull hour. I have met with persons afflicted by that mortal disease, consumption, prolonging their lives far beyond what their conditions warranted, by taking to the pursuit of natural science, or some engaging and useful occupation, which keeps the mind and body constantly employed in healthy and improving studies. All medical observers of experience must doubtless indorse this fact, indeed so patent, that it will be found, on the other hand, that inactivity of the mind in such like diseases hastens the fatal termination. The physician, therefore, will do well to find out from his patient, before finally recommending him to try the Egyptian climate, that he is not one of those cheerless and unhappy beings. To such a person the Nile voyage will soon become tedious, and most likely unprofitable. This is also the case with certain dyspeptics,

who frequently find themselves worse instead of better at their journey's end; indeed those in rude health, who have no active pursuits, mental or bodily, soon get tired of the monotony of the Nile-boat life, and the hum-drum existence which savours little of the enjoyment of the society of their homes. The well-deserved repute Egypt has gained of late years as a winter residence, in particular for phthisical patients, is of such a high character that no medical man who has made the voyage up to the second cataract, and noted the characteristics of the climate and capabilities of the country, but must long for the time when Egypt will become more accessible to the generality of invalids. The European hotels in Alexandria and Cairo are not only expensive, but very comfortless. The cheerless and dirty condition of many soon drives the invalid to his Nile boat, which may be obtained at either city; and dragomans also. It is essentially necessary, however, regarding the latter, that measures should be taken to discover the names of the best Maltese and Egyptian dragomans before the invalid's arrival, as many spurious individuals present themselves to him. The common mode of bargaining is to hire a boat and provision it one's-self. The dragoman is always ready to contract for the trip, but the invalid is at his mercy, and may be hurried up and down in order to give the interpreter another chance of a tourist before the cold weather has gone. I believe the invalid's best plan is to hire a boat himself, and allow the dragoman so much a day for messing, making arrangements as to the nature of the provisions and comforts to be furnished. These can be easily procured in the cities, but are expensive. In making arrangements with reference to messing, the consumptive invalid ought not to omit the *geshteh*, or what stands as the Devonshire cream of the East.

It is especially nutritive, and a good substitute for the native butter, which cannot be recommended even to the strong. The boat requires careful overhauling, as sailors would say, to see the *satara* (outside curtain) covers all the windows, and that the latter fit properly; that the cabin furniture, bedding, etc., are ample, and the crew are able-bodied men. A canopied or cushioned seat outside in front of the saloon, where the invalid can sit when the north wind prevents his going on deck, is a desideratum. Before starting, it will be well to hang about in the river for a day or two to see that "all is right," and especially observe if all the provisions have been put on board. A comfortless boat, without an outside curtain, full of draughts from badly-fitting doors and windows, obliging the invalid to shut him or herself up during windy weather, or even take to bed is enough to spoil all the good intended. On the above seemingly trivial points much individual comfort will depend. During November, and the three following months dew falls profusely at night all over the valley below Thebes but gets dispersed by nine A.M., and, in the form of fleecy cloudlets, is seen floating at high altitudes in a clear and delightfully serene atmosphere.

Climate.—In Nubia, as the cultivated tracts disappear and the desert approaches the river, dew all but vanishes and thus, after passing the first cataract, the climate, from being more or less moist, becomes exceedingly dry. Indeed after all, the grand advantage of the Egyptian climate in winter, is its daily serenity and sunshine, for, however strongly the wind blows, a sheltered nook after nine o'clock in the morning will always be a sunny one. To persons therefore, with susceptible air-passages, it is agreeable to

know this circumstance. Here and there along the banks we observed the graves of patients, who, for the most part, should have stayed at home; but as in all countries in high repute for invalids, there are great numbers of infirm persons who will persist in making pilgrimages thereto when at best they can only be "hoping against hope." No doubt the climate of Upper Egypt, Nubia, and the Desert, from their superior dryness, are better suited for the generality of tubercular patients than that of the Delta and dank tracts of the low country. Much, however, depends on the patient's condition, but Nubia appears to me well adapted for phthisical persons, to many of whom the sharp bracing air of the desert may be too strong. Accordingly, if he feels benefited by the voyage, on his arrival at the first cataract, he should push on to the second, and tarry in Nubia as long as the weather permits. He may return to the first cataract towards the end of February, and bask for a few days in the sunny creeks about Asowan and its rapids. There he can enjoy ine scenery and a delightful climate,—if able, and inclined stroll through Philœ's interesting ruins, he can anchor his t in the sheltered corner just under the noble old temple Æsculapius, perhaps no unsuitable place for him who els the better for his Nubian tour.

Meteorological changes such as the following are of requent occurrence in Upper Egypt and Nubia during the old nights:—A dead calm and considerable heat is succeeded at dusk by a heavy dew-fall, the thermometer egistering often 35° Fah. at midnight. The moisture rises with the sun, and, being dissipated before ten A.M., dapples he firmament with cumuli. Then about mid-day there comes rush of north air up the valley, fresh and strong, continuing o sunset, or longer, accompanied by dust-clouds, dense and

penetrating—as if the inordinate heat of the previous day caused an indraught of cold air from the Mediterranean.

Such-like conditions continue now and then throughout the winter, forming withal a delightful climate, neither too hot nor too cold, with beautiful afternoons, delicious and short-lived sunsets, when the last rays of the orb of day on the desert, or reflected from the bosom of the Nile, impinge straight on some of the glorious monuments of antiquity, to light up pictures no pen can describe, and the pencil barely takes in their wondrous lights and shades; then at dark are observed long lines of pelicans gliding close to the surface of the river, as if skimming over glare ice, so near that their great wings almost touch the water; while higher are observed numerous other wild fowl, holding their course towards the shallows; and at last darkness sets in, and as we sit on the poop of our Nile boat, enjoying the cool fanning breeze, nought is heard save the croaking of the frogs, or the *chip, chip, hoit* of the black-winged plover on the bank.

I.—MIGRATORY BIRDS.

DURING the voyage to Alexandria we observed many migratory European birds crossing towards Africa. The hoopoe, redbreast, and redstart often passed the vessel, and the pied wagtail shot across the billows, now dipping into the trough of a wave, anon topping its crest, and still onward in about a direct southerly course. The excessive numbers of this bird met with in the Nile Valley and Northern Africa during winter, and its disappearance again in April, show the completeness of its exodus and arrival in both continents. This familiar tenant of

modern Egypt seems to have been equally well known to the ancients. There is a beautiful picture on the walls of the tomb of Beni Hassan, representing the more common birds of the period. The fowler is observed hauling his clap-net, which is filled with geese and ducks, and just the very species we find most plentiful in the marshes now-a-days, whilst perched on a sycamore or Nile acacia beside him we at once recognise the pied wagtail, kingfisher, hoopoe, and others. There is some exaggeration in the colourings, but otherwise they are light and clear, as when traced by the artist more than 3000 years ago! There is a bird in the hieroglyphics expressing anything "impure or wicked," which some have considered may have been intended to represent a swallow, whilst others think it may be the wagtail, from the circumstance that it is called "aboo fussad" (father of corruption) by the modern race.

Accuracy of the Drawings and Sculptures of the Ancients.—There is no feature of the Egyptian monuments more striking than the accuracy in the outline, and often in the colouring,[1] of animals and objects done from 3000 to 5000

[1] The reader, without going as far as Egypt, may see some fine examples of this accuracy of outline and colouring in the Egyptian Galleries of the British Museum, particularly in one painting or fresco, where an Egyptian fowler with attendants is figured in his boat. Although this be a mere fragment, there is a small piece of the Nile, with some of the characteristic birds swimming among plants of the lotus. On the banks, among and over beds of bulrushes, and the *Cyperus papyrus*, are different species of waders and web-footed birds, with their eggs. There is one of the smaller Insessorial birds, and a characteristic butterfly of the Eunplœa genus, while a cat, very like one figured by Dr. Rüppel, and evidently trained, seems to be a very active assistant to the fowler, who has a throw-stick in his hand. Look at the colossal head of the ram in that gallery—it is evidently a study from life by a most able artist of animal features.

years ago. For example, in those referred to on the walls of Beni Hassan, or the intaglios, on the celebrated obelisk of Tuthmosis I., there are displayed a clearness of expression, boldness, and truthfulness of outline, in every way surprising. The observer, standing among the broken fragments of its sister monolith, and looking upwards on the finely sculptured and polished sides of this noble work of art, can scarcely realize the fact that since its construction more than twenty-four centuries have passed away. What modern artist from the most learned academy of Moslemdom has or ever did possess such refined skill, nay, has even attempted to imitate the grand achievements of those old-world folks, whom in gross ignorance of their history and greatness, the degenerate Egyptians contemptuously designate "the Pharaoh people," and wonder what the infidel can mean by collecting all their useless trash?

Selection of Animals by the Ancients to represent Ideas.—Although there is considerable likelihood that the ancients may have chosen the animals and objects of their hieroglyphic writings from some real or imaginary attribute possessed by each, yet in the case of the wagtail it would puzzle a modern to discover the reason why it was selected to represent "evil actions." I can well imagine the "sparrow" was the bird from which the ideal was drawn, for whilst at the present day none of the Nile birds are more numerous, few are more destructive to the crops. The pretty congener of the pied wagtail, named the yellow wagtail (*Budytes flava*), may be seen in flocks in grass and stubble fields, and a solitary individual of the grey-throated species (*Motacilla boarula*) is occasionally observed on the banks or by the side of inland pools. I beg to direct the especial attention of the student

to the handsome and attractive sombre wagtail (*Motacilla lugubris*) of the cataracts. There its active figure is seen running at full speed around the margins of the eddying bays, now hopping from one torrent-worn boulder to another, then alighting for a moment on the deck of the boat, as with a loud and lively chirp it shoots along the surface of the surging waters. Could the sudden appearance and departure of this little visitor to the ancient, as he towed his bark through the torrents of the cataract, have suggested to him the idea that it was a bird of bad omen, and thus fit to represent "evil actions" in the construction of his mysterious language? I should be inclined, however, to give the sparrow the right to this immortality, for even at the present day enormous flocks of the two sorts, viz., the domestic (*Pyrgita domestica*) and Spanish sparrow (*P. salicicola*), assemble in the fields during harvest, and more especially at sunrise, when boys, armed with slings, repair to the fields, and attempt to drive them away. The latter bird is the most destructive, whilst the other, with all the familiarity of the European sparrow, prefers the habitations of man, and the dust and filth of the crowded city and Arab huts, to the open country. During December it is a pretty sight any evening to stand on the bank at Luxor, as the sun dips behind the limestone cliffs above the Necropolis of Thebes, and observe the vast flights of sparrows passing towards their roosting-places. You are suddenly surprised by a rush of wings overhead, and looking upwards, a dense mass of thousands of sparrows is seen oscillating and wheeling from side to side, up and down, like a huge army performing evolutions, and with an exactitude perfectly wonderful. There is a bird in the writings intended to represent the word "prolific," and considered to be the sparrow or swallow. I have seen it on

the granite obelisk at Karnak, where it is well shown; but there it has not any similitude to the above, although it must be confessed that the amatory character of the sparrow gives it the preference over almost any other of its race.

The Swallow of Egypt a variety of the Chimney Swallow of Europe.—The chimney swallow, and also the red-bellied race of the same species, are found in Lower Egypt, but the last is *par excellence* indigenous to the Valley, whilst the other is met with only in April on its way to Europe. It would be interesting to find out where the individuals of the latter, seen in Egypt in spring, take up their winter quarters.[1] Perhaps they are coasters from the countries lying to the east and west; but of one point I feel certain, that the true *Hirundo rustica* does not winter in the Valley of the Nile, at all events northwards of the second cataract. Supposing the former to be only a variety or race of the latter species, it seems indeed strange that with this mixing together in spring, the red-bellied sort does not migrate northwards with the other. Now, the interesting points in connexion with this so-called variety, or permanent race of a well-known bird, are, 1*st*, Will the two breed together? 2*dly*, Do they mingle together? because, if they do neither,

[1] In unpublished notes on the birds of Egypt, made by the late Lieutenant W. Osburn, R.N., and kindly lent to me by his brother, Mr. Henry Osburn, I find, among much valuable information on the habits and haunts of the birds of Egypt, the following suggestive remark:—"The European chimney swallow, and also the sand-martin, are seen in flocks about Cairo in April. They only remain for a short time, and must visit the Nile Valley only on passage northwards. Is it not remarkable that a migratory swallow should thus pass over the country inhabited permanently by a red-bellied race of its own species?" The white-bellied chimney swallow frequents Syria and Northern Africa westward of Egypt, and has been found in winter on the western shores of the Red Sea.

there are distinctions in their plumage which would seem sufficient to claim for each specific characters. Perhaps by some unknown natural selection, the Egyptian variety has descended from the other. It would, however, be premature to speculate on this subject until the exact geographical limits of the red-bellied swallow have been clearly defined, and I am not aware this has yet been definitely fixed.

The student is not long in Egypt before his attention is directed to the little brown crag swallow (*C. rupestris*), so generally distributed over Egypt and Nubia. Flocks of this little active creature are common; it much resembles the bank-martin of Europe in plumage, habits, and haunts; but may, however, be easily distinguished from the latter, as much by its colouring as its feebler flight. By the river's banks, under cliffs, over the surfaces of lakes and pools, more especially the famous tank among the ruins of Karnak, flocks of crag swallows may be observed skimming noiselessly about; but they delight most to haunt around the acacia and thickset bush which line the Nile in Nubia for long distances. There, in the haunts of the chameleon, around the clustering creepers and spider-webs that cover the gnarled old camel-thorn, this active little martin sports, while the sweet "hōōet" of numbers of chiff-chaffs (*Sylvia rufa*), fluttering like humming-birds around the fragrant yellow flowers, and the welcome forms and melodious notes of the lesser white-throat (*Sylvia curruca*); and Sardinian warblers (*Sylvia sarda*—Temm.), form a pleasing melody in the otherwise howling wilderness. I have counted several hundreds of them in and around one small acacia, all intently searching for food; the two latter mostly employed in picking the dense masses of cobwebs to pieces, not apparently so much for the spiders as the numerous flies entangled in the meshes.

The black swift (*Cypselus apus*) winters on the Nile southward of Thebes. I fancy the climate of Lower Egypt is too cold for it then.

The European (*Alcedo ispida*) and pied kingfishers (*Ceryle rudis*) are the only representatives of their family to be seen on the Nile between the Delta and the second cataract. Both are most plentiful in the former, and decrease in numbers southward. The pied kingfisher is a very prominent object on the river's banks; now hovering hawk-like for several minutes over the same point with its big bill depressed, then by a beautiful and graceful sweep it stoops a short distance, and, rising, continues its fluttering motions, and before we have time to point its place, down like an arrow it drops on the surface, and is up and off to the nearest branch or post with its scaly prize firmly held in its powerful bill.

II.—FAMILIAR BIRDS OF EGYPT AND NUBIA.

EGYPT and Nubia vary considerably in their physical and geological features, and in the numbers and distinction of their wild animals and plants. The great expanse of cultivation in the low country and outlets of the Delta, with their shallow marshes and sandbanks, offer admirable retreats for water birds, which decrease in numbers southwards. The grand host of winter migratory species impinge as it were on the Delta, and move southwards, decreasing where local circumstances are inimical, and crowding where such are favourable. Thus, after passing the first great barrier at Asowan, and proceeding southwards, we suddenly notice the absence of all geese, ducks, and waders, which crowded the shallows below the first cataract. A few falcons now scour the narrow

strips of cultivated land, and the desert chats and sand birds we had to search for in Lower Egypt far inland, and beyond the limits of the inundation, are here met with among the cliffs and wastes along the river's banks, whilst such as the hooded crow and other familiar denizens of the north country have all but disappeared—here for the first time my ears were assailed by sounds reminding me of Indian jungles, for the mellow chirruping call of the bulbul (*Pycnonotus arsinoe*) is heard among the palm groves of Wadai Halfeh, and among the tangled acacias flits the garrulous bush-thrush (*Crateropus acaciæ*), both showing we are now on the confines of a new ornithic province, the northern outpost of which is Nubia. Neither of the two birds can be well overlooked by even a casual observer, the sombre hues of the first, feeble flight, and chattering of flocks of the other, constantly relieve the sameness of many a day's wanderings on the banks of the Nile in Nubia. The sombre bulbul is about eight inches in length, whilst the bush-thrush is about ten inches, with light brown soft plumage, the edges and sides of the mouth being yellow. It breeds in midwinter.

During a morning ramble on the rocky face of a ravine at Dendor, in Nubia, I was suddenly surprised by a covey of some six or eight small partridges getting up before me, and managing to shoot a female, discovered it to be the pretty little pigmy red-legged partridge (*Ammoperdix heyii*), the representative of a genus of remarkably handsome and attractive game-birds, of which its close ally, the pigmy red-leg of India (*A. bonhammi*) had, in former days, been familiar to me. Like to it in plumage, the Nubian bird is partial also to the same localities, frequenting bare ravines and low hills. It runs at great speed, and secretes itself

under detached masses of rock. When flushed it emits a clear whistle. The flesh is pale and tender, but has not much flavour. It is found likewise in Syria, whilst the other extends again westward to Persia. The sycamore, acacias, and palms, with the tamarisk and a few willows, are the chief, and indeed almost the sole, trees of Egypt and Nubia. The first grows almost exclusively in Lower Egypt, and seems to decrease southwards. The acacias, more especially the Nile acacia, throws grateful shades over the native's dwelling, whilst the date palm, and its more picturesque congener, the doom, are plentiful about the towns and villages, but neither are very favourite resorts for the feathered tribes. The palm forms an eligible perch for the raptorial birds and their sallies, but the great absence of other trees and low brushwood accounts for the partial appearance of many, and total absence of others, such as the woodpecker, only represented in Egypt by the wryneck (*Yunx torquilla*) of Europe. The cliffs of nummulitic limestone and silicious sandstone, at various points on the river, afford excellent retreats for hawks and other birds of prey—also the cormorant. Here, among the ancient rock-cut tombs of man, and the still immeasurably older excavations of primeval Nile, they rear their young undisturbed.[1] Yet the scenery of both countries is tame, and their botanical productions neither varied nor interesting. Moreover, there is no great diversity of birds, which, however, make up for this by exceeding

[1] In the rock-cut sepulchres at Manfloot, numbers of falcons and cormorants breed, and often at dusk several hundreds of the latter may be seen roosting on the palms in the neighbourhood. The cormorants perched on lofty trees remind one of Satan in Milton's *Paradise Lost*, iv. 194, 195, 196:—

"On the Tree of Life
(The middle tree, and highest there that grew)
Sat like a cormorant."

numbers. On proceeding inland, and passing across some great level, covered with splendid crops of sorghum as high as a man on horseback, we are astonished at the myriads of crested larks,[1] which, with their well-known chirp, flutter and rise up before you. The pretty bluebreast (*Cyanecula suecica*) hops around the margins of the fields; flocks of Spanish sparrows (*Passer salicicola*), and semi-domesticated blue pigeons, red-throated pipits (*Anthus rufogularis*), and yellow wagtails, are in numbers in the stubble-fields. In bushy places the wren-warbler (*Suya gracilis*) emits its loud "creek" as you approach; the green bee-eater[2] is seen frolicking over fields, whilst the kestrel and kite are hovering over the crude brick villages, and their never-failing date-

[1] *Alauda cristata.* In the notes of the late Mr. Osburn, he states that this species is "very pugnacious during the breeding season, and the males throw themselves into fantastic attitudes when coquetting around the females." This lark does not soar on high, and sings on the ground. Its note is short, and not so varied as the song lark's.

[2] I have seen the green bee-eater and chiff-chaff almost benumbed by a temperature of 40° Fah. in Nubia. The first, however, is a lively little creature on sunny days, and may be seen sporting about with great vigour, now shooting from the extremity of an acacia branch, anon flitting from furrow to furrow in a newly-ploughed field; now four or six are clustered together on a branch, then suddenly, with loud shrieks and chatterings, they break off in divers directions. It is, however, a stupid bird, and allows one to approach within a few feet. Not even the report of a gun seems to frighten it. The following extract from Mr. Osburn's diary I take the liberty of transcribing:—

"*Sioot, 23 January* /57.—The bee-eater usually sits on a twig or palm-leaf, often two or more together, and from thence dart after their food, which, so far as I was able to observe, does not consist so much of bees as moths and butterflies. Their flight, though very rapid, has much more *flutter* than swallows. They do not dart at the insect directly, and take it at once, as then probably the rush of air would aid (especially *lepidoptera*) the prey to escape, but going below with *poised* wings, they make a sudden and very rapid curve upwards or sideways, and snap it with wonderful quickness. In these rapid turns they are doubtless much

trees, which resound with the incessant chirp of the house-sparrow, and the soft cooing of the Senegal dove.[1]

Directing our course desert-ways, until the river alluvium becomes less heavy, we suddenly arrive at a well-marked and abrupt line of demarcation, which records the limits of the year's inundation, and soon we are on the verge of the desert, where the linnet (*Linota cannabina*) and trumpeter bullfinch (*Erythrospiza githaginea*) are seen herding together, and we recognise the chats and sand-loving birds of the region. The clear tinkling call of the trumpeter bullfinch is heard on the borders of the desert, where its dull greyish-brown plumage, consorting so well with surrounding objects, hides it from view. The delicate rose-tinge on the general pale hue of the plumage, is very pretty, especially in males at the breeding season. The tombs in the Necropolis of Thebes are a favourite resort of this bird, where it takes up its abode in the company of the domestic sparrow. I have often watched a sparrow-hawk stoop on a flock, and bear one off in his talons, when the entire assemblage set after him in pursuit, emitting, as they went, their clear and musical notes, so characteristic of the species. This bullfinch commences to pair in February, but for some time beforehand I noticed the males constantly making love, and

aided by the long beautiful feathers of the tail. They then as quickly return to their post, and, with merry swallow-like twittering, knock off the wings of their capture against a branch, their whole plumage glistening with emerald and gold at every movement. The light takes a golden colour when their expanded wing is seen against it."

Note.—In this habit of returning with the capture to a fixed station, and watching from it for more, they closely resemble *Alcedo* and the fly catchers, and differ from *Merops apiaster*, which swallows its food on wing.

[1] The modern Egyptians have a great regard for the dove, and say its call is made up of the exclamation—"Ya Kereem, ya Allah!" (O merciful God!)

coquetting around the females, and that the gallants were the largest and richest plumaged males. There seem a few nightingales, and the redbreast migrates from Europe to Lower Egypt in small numbers, but it is there far less familiar than in England.

Bird Migrations.—It seems inexplicable how many birds find their way back to exactly the same haunts of the previous year, and this is more extraordinary when we consider the distance between their winter and summer retreats. I have often wondered how tiny warblers find their way from Northern Europe to Central Africa, and at the very short time spent by certain birds on their journey. The cuckoo appears in England just as soon as we find it in Southern Italy. It has seemed to me that bird migrations may be performed in the following ways:—Such birds as push furthest inland at one point, do not do so at the other. For example, the swallows and insectivorous birds that frequent Northern Europe, may content themselves with the climate of Algeria and Lower Egypt, whilst the rest from Italy and Southern Europe push to equatorial latitudes, and *vice versa.* A great many warblers from Northern Europe spend their winter in the south, and in the islands of the Mediterranean, whilst the majority go still further southwards. But why should individuals of the same species remain in cold climates, when others migrate to warm countries? For example, the redbreast braves the severest winters in Britain, whilst the robins of Southern Europe migrate to Africa, and the same may be said of the song-thrush and blackbird; and I ascertained that the same birds as met with in the south, are relatively smaller than their northern compeers. The power to resist very low temperatures is

somewhat strange. I have noticed the pied wagtail, as well as the bee-eater and chiff-chaff, become feeble when the thermometer stood eight or nine degrees above freezing. What a contrast to the pigmy golden crests and titmice of northern regions, where we find them lively and moving about at a temperature of 24° to 30° below zero of Fah.! The pliability of some animals' constitutions is wonderful. The turkey seems to thrive in every clime,[1] and the guinea-fowl may be seen running wild at the equator and around the farm-yards of Canada during the severest winters. Some migratory birds evidently breed in both their summer and winter retreats, but the majority prefer the former season; and we may, I think, fairly expect that the country best suited to the bird's constitution is that in which it rears its young. I have noticed many birds of passage in Egypt appear inactive, as if they were merely enduring their existence for a time until spring should set them free.

IV.—RAPACIOUS BIRDS OF EGYPT AND NUBIA.

THE Egyptian vulture (*Neophron percnopterus*), or "Pharaoh's chicken," is well represented on the monuments

[1] Mr. Darwin (*Animals and Plants under Domestication*, p. 355) states on the authority of Mr. Blyth, that the turkey degenerates in India. Perhaps the deterioration of race is more owing to neglect in the selection of improved stocks. Even the fowls of India, although in the native climate of the species, are smaller than English breeds. The turkeys I saw in Egypt and in the Northern Punjab showed no marked degeneracy as compared with English birds, although darker in colour. But what is still more important, when we consider that the progenitors of the turkey are natives of the warm and sub-torrid regions of North America, the fact (of which I had ocular demonstration), that the turkeys in New Brunswick are not only equal in size to any breeds of Europe, but during winter prefer to roost on trees on open and exposed situations rather than under the shelter of outhouses.

This is also the rakham of the Arabian historians, and the gier-eagle of Leviticus xi. 18. The "bird and globe" on the monuments, representing a king or Pharaoh (according to Horapollo "an eagle"), is not feathered to the toes, and its slender bill and general outline bear a close resemblance to this vulture. It is still very common throughout the country, and breeds in the lofty crags on the banks of the Nubian Nile. The darker plumage of the cinereous vulture (*V. cinereus*) serve to distinguish it from the griffin (*Gyps fulvus*), both of which are not uncommon, and often the two may be seen feeding in amity on the carcass of a camel or bullock, where great numbers assemble at very short notice. I scarcely think a day passes that one or other may not be seen soaring at vast altitudes. Besides the signification of "mother," on the supposition that it suckled its young (from perhaps the bare crop and denuded feathers on the chest), this vulture was sacred to the Egyptian Minerva and Lucina, appearing as their head-dress, and also that of the queens of the country. The colouring of all the vultures I have seen on temples is in a degree whimsical, but their outline in general shows great artistic skill, more especially delineations of vultures on the walls of a temple at Thebes, excavated during our excursion.

That magnificent eagle vulture, the bearded vulture (*Gypaëtus barbatus*), does now and then visit Lower Egypt, for on the 14th of November 1863, when crowning the summit of the Great Pyramid, I came most unexpectedly on one resting on the platform at the apex. Most likely the individual was a straggler, attracted by the isolated conical aspect of the great land-mark, for after a few sweeps around its sides he steered his course majestically towards the Mogattam Hills. I do not think a more imposing picture of

independent majesty is to be seen than this magnificent monarch of the mountain, seated on some beetling crag, with quarry in his talons; the fiery red eye, the long bristling beard, acuminated feathers of the neck, and long plumes on the thighs projecting backwards towards the expanding wedged-shaped tail, the opening wings, all furnish materials for a fine picture.

The most common eagle throughout the valley, as far as my observations extended, seemed to be the spotted eagle (*Aquila nævia*). It feeds chiefly on reptiles, birds, and fishes. I discovered fragments of a large snake in one killed near Thebes, and on another occasion surprised a pair intently devouring a large lepidotus.[1] A mummied eagle discovered by us in a tomb in the Necropolis of Thebes agreed with the admeasurements of this species; its stomach contained fragments of a small bird. The dwarf-eagle (*Aquila pennata*) is also a native of the river's valley. Although both Diodorus and Strabo say the eagle was worshipped at Thebes, it is possible they may not have been certain that the bird referred to was one or other of the above, or some of the larger falcons. An eagle-like bird often occurs in the hieroglyphics, where it has the force of the letter A.

The osprey (*Pandion haliætus*) and the long-legged buzzard (*Buteo rufinus*) are prominent objects on the river's banks, affecting also the canal banks and the open country, where the latter feeds on rodents, lizards, snakes, and frogs. A steady friend of man, and just as its European congener was wont to ply its scavenger trade in the streets of London, so does the black kite (*Milvus ater*) at the present day in

[1] This fish, still common in the Nile, is the representative of the extinct ganoids met with in the Cretaceous and Lias formations, and the recent gar-pikes of the American rivers.

the filthy lanes of Cairo. Assisted by its ally, the Egyptian kite (*M. ægyptius*),[1] which may be distinguished from the other on wing by the pale colour of its bill, they hover over the refuse-heaps, slaughter-houses, and wherever carrion and offal are collected, now pouncing on their food, and bearing it off in their talons, or, with that remorseless activity characteristic of the genus, pursuing pigeons until the terrified bird, worn out by exertion, sinks exhausted, and is despatched by its enemy. Nor is this all: the fisherman has to keep a good look-out when he lands his net, as one or other is sure to be on the outlook for the small fry. They dispute the ownership of a bone with the lean pariah dog, pick up refuse floating down the river; they hover over the farmer as he ploughs his field, and are the dread of a village from the number of chickens they pilfer. The nest is built in the top of a palm-tree, where the Nubians catch them in traps baited with pigeons. Thus, being omnivorous, it plays a great part in the scavenger-work of Eastern cities, and fares no doubt better than in ancient times, as the old-world folks were more studious regarding the disposal of the dead bodies of animals, which were generally buried, and never, as at the present day, cast on the shore, to be carried off by the inundation, or allowed to fester in the sun; indeed, the consideration shown towards all carrion-loving animals by the ancient Egyptians is amply demonstrated in the history of their times, and forms a rather strange contrast to the general apathy and neglect of things sanative, as observed in the present occupants of the country.

The double-bearded falcon (*Falco biarmicus*), the peregrine (*F. peregrinus*), and lanner (*F. lanarius*), are not rare.

[1] Both species breed in midwinter in Egypt and Nubia, as indeed do many other rapacious birds, and the hooded crow, etc.

There seems to have been considerable inaccuracy in the drawings of many of the falcons, as seen on the monuments; at the same time, a few are exceedingly clear and accurate in the outline, and for the most part in colouring.

The domesticated hawk seen by Strabo at the first cataract may be one or other of the last-named species, but all the mummied specimens examined by us, and the drawings, paintings, and models found in the temples and tombs, lead us to the belief that the kestrel (*Tinnunculus alaudarius*) was the model from which the sacred emblem Horus Re, or the Sun, and a host of other deities, originated. The only other hawk at all like the last is the lesser kestrel (*T. cenchris*), its congener; but this small falcon is only met with in Egypt in spring, during its migrations, whereas the other is sedentary. Perhaps both were venerated, in the belief they were one species, as there are only slight differences in size and colouring of their plumages. The usual form and colouring of the sacred bird is unquestionably like the kestrel: a dark spot under the eye, red and black barrings on the back, with reddish white on the lower parts, which are more or less spotted with black. Its functions were, in conjunction with Anubis, to analyse the good and bad actions of the trembling soul before being ushered into the presence of Osiris. On that account, the hawk was held in great veneration, and the penalty of death awaited him who either wilfully or by chance put it to death. No trouble was spared in preserving them, so that besides the sacred birds in captivity, it was customary to place food in the way of wild individuals. The kestrel, therefore, must have enjoyed unbounded freedom and protection; and it is a remarkable circumstance now-a-days, with reference to this bird, that being one of the most common rapacious birds of Egypt, it is far more familiar than

any of the others, allowing man to approach it within a few yards. I have often thought that this feeling of security may have been hereditary. At all events, whilst there is never any difficulty in getting quite close to a kestrel, the sparrow-hawk and other small birds of prey are in no ways different in habits in Egypt from the same species elsewhere.

Sacred Hawks.—Whenever the sacred hawk died its body was handed over to the embalmer, and subsequently deposited in a sacred tomb. It mattered not where or how it had met its death; in common with other sacred animals it was wrapped in linen cloths, and followed to the grave by a procession of mourners, whose outward signs of grief were shown by beating their breasts, and by such voluntary penances as testified to the veneration with which these animals were held. Even the hawks which died in foreign countries were embalmed and brought to Egypt. I have seen nothing on the monuments at all like the sparrow-hawk, which Sir J. G. Wilkinson names the kestrel. The latter does not prey on birds, but is almost partial to beetles, and in particular the sacred scarabæus, which it finds in abundance along the slimy tracts of the river. The sparrow-hawk, kites, and the hooded crow, wage a perpetual warfare on the little kestrel, which screams lustily as the others pounce past him. Again, as the kite is stooping on his quarry, the hooded crow, on the alert, gives chase, and often obliges him to forego his hold. This crow is a bold marauder, and may be seen disputing priority with the bald-headed vultures around the carcass of an ox or camel. The raven and rook are both met with in Lower Egypt, the former also in Nubia. The moor buzzard and Swainson's blue-hawk are also both plentiful during the winter months,

and likewise the little black-winged kite, which may be seen in numbers along the railway route from Alexandria to Cairo.

V.—POULTRY OF THE ANCIENTS.

THE universal use of fowls as articles of food is said to be an argument against the probability of these birds having been sacred, but, as I will presently have occasion to point out, that the Nile goose (*Chenalopex ægyptiaca*) was an emblem of the god Seb,[1] and the white-fronted and possibly the grey goose were extensively used as articles of food, which numerous delineations on the monuments clearly testify. Like the humped bull, the domestic fowl came doubtless from Asia to the Nile Valley, and perhaps it may have been their foreign origin that caused them to be rejected as sacred animals. The bird so frequent in the hieroglyphic writings, representing the vowel *o* or *u* in the oval of Shofo, the builder of the Great Pyramid, resembles the young of the domestic fowl—at all events, the rudimentary wings and bulging of the abdomen favour the belief of its being a young bird. The quail also naturally seems to one's mind as being the ideal from whence this figure was taken, and although not apparently sacred, was often represented in the sacrificial pictures among the offerings. It is common throughout the valley, in suitable situations, chiefly in grain-fields and patches of vetch. The present race of the domesticated pigeons of Egypt preserve a remarkable similarity to the wild rock-pigeon, which is plentiful in appropriate situations throughout the country.[2]

[1] Wilkinson, *Manners, etc., of Ancient Egyptians*, vol. iii. p. 214. It is possible that the vulpanser was not eaten, and may have been the sacred goose referred to. There is no doubt, however, that the others were salted and preserved for summer use when these birds are not found in the Nile Valley.

[2] The tame pigeon of the Egyptian pigeon-houses agrees with the *C.*

Many coloured varieties of the former are also common; but these are kept in the houses of the natives, and rarely mix with the denizens of the public pigeon-houses. Each town and village has its dove-house, the conjoint property of many persons. The birds being kept solely for their dung, are allowed to shift for themselves; no doubt stragglers frequently take to the wild life. At Sioot they may be observed swarming around their cots like bees about their hives, or settling in flocks on the tops of palms and other trees. I have seen them hunting for food on the river, and, after the manner of gulls, picking up substances from the surface.[1] This decided reversion towards the wild state, as it may be truly called, is doubtless owing to the fact that no pains have been taken to produce varieties, and the birds are allowed to shift for themselves; there being always, under such circumstances, a strong disposition to return to the original type. I make no doubt, that provided none of the many-coloured sorts are allowed to breed with the others, that the latter would entirely revert to the plumage of the rock-pigeon.

Domestication of Pigeons 3000 *years* B.C.—In connexion with the semi-domesticated condition of the pigeon, as observed in the native cities of Egypt at the present day, and the evidence furnished by the monumental pictures, we are compelled to admit that the ancients in the above case, as well as in that of many of the arts and customs of civilized people, were far in advance of the present occupants of their country. Let the student, when he has carefully inspected

schimperi of Bonaparte; but many individuals were procured by me in no ways different from *Columba livia*.

[1] This habit is not uncommon with rooks, as may be observed frequently in Queenstown Harbour, Cork.

the magnificently executed intaglios and paintings of natural objects on the walls of Karnak, "the largest and most splendid ruin of which either ancient or modern times can boast," pass up the once famous avenue of sphinxes to the temple of Luxor, from thence cross the river to where once stood Thebes, "the world's great mistress on the Egyptian plain," now teaming with rich fields of grain, and by Memnon, to the ruins of the temple of Medineet Haboo, where he will see delineated a scene which took place on the ground he has traversed, at a period no less remote than 3000 years ago. It represents the coronation of the famous warrior-monarch Rameses III. (B.C. 1297.) He has just been crowned, and the gay procession is marching up the noble avenue of sphinxes to the palace temple of Karnak, and by the same route he is seen returning from war, when the conquering hero, among the clamours of the populace, and shouts of his victorious army, is proceeding to the temple to offer his grateful thanks to the gods; and whilst certain priests in their gorgeous robes are casting incense about, and offering up sacrifices at many a smoking altar, others are employed in letting off carrier-pigeons, to announce the glad tidings to every quarter of the globe. Thus, more than thirty centuries ago, pigeons were so far domesticated as to be used for the purpose of conveying information; and we have the further authority of Dr. Lepsius and Mr. Birch, that they were used in Egypt as articles of food no less than 3000 years and upwards before the birth of Christ. These facts, taken in conjunction with others, together with the well-known examples of races of dogs, as divergent in form as any to be met with in the present day, surely testify to a state of refinement and civilisation we should not have expected at that very distant epoch in the history of mankind.

VI.—OLD-WORLD PICTURES.

AMONG the numerous delineations of the social life of the ancient race, there is one preserved in the British Museum, where the steward, in the presence of the owner, is counting geese and ducks, whilst the menials under whose charge they had been placed are making obeisance to their master. Ducks and geese were favourite votive offerings. In the pretty little temple of Amada, I observed a scene of this description, the colouring being still clear and distinct, in consequence of the picture having been sealed up for many centuries by mud, with which the early Christians bedaubed the walls of the temple, in order to efface all records of the idol-worship of their predecessors, little aware, at the same time, what delightful paintings and sculptures they were preserving for future generations.

Sir Gardner Wilkinson is disposed to consider that the cattle egret was the sacred bird named the "tufted benno," an emblem of Osiris, and chosen in consequence of its familiarity and predilection for cultivated districts, and feeding on insects and worms turned up by the farmer. The bird is very plentiful along the river's banks, and in fields, and is the white egret so frequently pointed out by dragomans as "the ibis." It feeds chiefly on frogs, which are exceedingly plentiful after the inundation. The best drawings of the tufted benno I have seen rather incline to the belief that the ancients meant the night-heron, with its long white plumes. This tenant of the river may be seen during the day resting on the tops of palm, tamarisk, and acacia trees;[1] and after dusk, when the other water-fowl have settled down for the night, the unwieldy form of the night-

[1] The tufted benno is often so represented in the ancient pictures.

heron, with head well back, silent, and measured flappings of its great fan-shaped wings, is apt to startle the unwary traveller as it passes overhead, uttering its well-known "wak," "waak."

On the augural staff of the gods, I have more than once recognised the head of a bird exactly similar to the crested lapwing (*Vanellus cristatus*), which may be seen in flocks along the shallows. Cranes (*Grus cinerea*), white (*Ciconia alba*) and black (*C. nigra*) storks, are unmistakably portrayed in the paintings on the walls of Beni Hassan. A group of the former driven by a man might induce the belief that the ancients domesticated the crane. When they wished to represent a person skilled in astronomy, they drew a crane. The conception was good, as the bird soars at vast altitudes. There is a small lapwing plover, known as the white-tailed lapwing (*Vanellus leucurus*), not uncommon in winter both in Upper and Lower Egypt. It is an easterly bird, and Egypt is about its furthest western limit. It is met with also in Northern India,[1] but until lately was supposed to be an exceedingly rare bird everywhere.[2] Mr. Osburn found it plentiful on the lake of Edfoo, and I have seen it by the sides of pools in the Thebaid.

The vulpanser[3] of Herodotus is, beyond doubt, the Nile goose of the present day; but the colouring is incorrectly given, and there seems a pretty constant disposition on the part of the artist to give it a tail like that of the pintailed duck. In the Theban temples, and wherever the colouring has been preserved, its head is painted red, breast and belly

[1] *Wanderings of a Naturalist in India*, p. 154.

[2] This is the *Vanellus vieillotti* of Savigny, *Description de l'Egypte*, who says it is found nowhere but on the banks of the Nile—hence the propagation of his error for over forty years.

[3] *Chenolopex ægyptiaca*.

blue, back yellow, with the tips of the wings red.[1] This seems to have been the ancients' mode of representing the Nile goose, and I have said incorrectly. Perhaps the discrepancies in the bright colouring of its plumage may have been taken from domesticated varieties, or else the colouring exhausted the resources of the old-world painter. The goose was the emblem of Seb, the father of Osiris, but was not sacred; it signified a "son," and consequently occurs very often in the Pharaonic ovals, signifying "son of the sun." Horapollo says it was adopted in consequence of its affection for its young. Although not so common as the white-fronted bird, the Nile goose is extensively distributed, from the Delta most probably to the very sources of the river, and far beyond.

The ancients took their ideal of "red" from the colour of the flamingo, and accordingly the bird, in the animal writings, stood for that colour. I wonder if they associated anything religious or mysterious with the flight of this strange-shaped wader. A flock, advancing on wing with their very long legs, and necks extended to their fullest extent, short wings, and the red and white colouring of the plumage, are strange and fantastic objects indeed, and to an observing and superstitious people could scarcely have been overlooked among less attractive animals. The sandpipers are numerous, the crimson, green, and red-legged species being the most plentiful. Of ducks, divers, and such like, there is a great assortment during winter; nearly all, however, migrate northwards to Europe in spring. Wherever the river is inviting, and

[1] Hybrids of this goose and the penguin duck have been raised in England, and, considering the aptitude of the ancient Egyptians in domesticating and selecting good breeds, as shown on the monuments, it is not improbable that the difference in form of tail and colouring may, after all, be no great exaggeration, and that a cross between it and the pintailed duck (very common in the Delta) may have been of frequent occurrence in their domestic states.

chiefly in the Delta, and southwards to the confines of Nubia, we find the mallard, teal, gargany, and castaneous ducks, widgeon, shoveller, pochard, tufted duck, ruddy sheldrake, gadwall, smew, red-throated diver, crested, horned, eared, and little grebes.

VII.—INACCURACY OF THE COLOURINGS OF SOME OF THE PICTURES.

It is apparent, that when the ancient Egyptians seemed to study with care, and represent, with all the accuracy possible, truthful outlines of the objects on their monuments, either through want of materials, or desirous to make the figures more attractive, they often exaggerated the colourings. As examples, the pied wagtail is shown with a red breast. Many of the vultures and hawks on the temples and elsewhere are very fancifully coloured.[1] But what strikes the student of nature is, the vast assemblages of objects are scarcely without exception natives of the country, thus showing that the language of which they are the expressions took its origin in Egypt; for it is in vain we look for the characteristic animals of foreign countries—not, indeed, as far as I have been enabled to discover, among all the imported animals from Europe and Asia, as in the case of the bear, etc. We find them in the paintings, but not in the hieroglyphic writings.

Tombs of Beni Hassan.—This takes me back to the famous Beni Hassan tombs, where one may spend days in studying the natural history, manners, and social life of this extinct but remarkable people. Besides many wonderful representations

[1] The white and black bars on the breast of the white-fronted goose are always faithfully rendered. Their absence in other pictures indicate that the greylag was the species meant to be represented.

of the social life and religion of the ancient Egyptians, there are several admirable drawings of the wild quadrupeds of the region; among others we observed the stag, Caucasian ibex,[1] oryx, gazelle, wild sheep, wolf, fox, hare, porcupine, cat, rat, and pig.[2] One picture represents men holding geese, whilst others are forcing substances down the birds' throats, by some supposed to be sickly individuals; but it may be possible that the modern cramming process was then practised. In connexion with the rat, there appears to be a brown species (*Mus cahirinus*) peculiar to the country, and closely allied to the Norway rat, which, as a matter of course, is plentiful also. The large hog-rat of this portion of the continent seems also very much like its congener of India, the *Mus giganteus* of Hardwicke.

The Cat.—The antiquity of the cat as a household animal is vividly portrayed on the most ancient sculptures and paintings. There were evidently two or three varieties, one of large dimensions, equal apparently in size, and agreeing much in colour, with the wild species (*F. chaus*), and *F. maniculata.* The cat appears in several hunting scenes, where the fowler, accompanied by his children, is dealing destruction among hosts of wild-fowl by means of "throw-sticks,"[3] and as his

[1] The antlered deer, figured on the monuments, represent possibly the fallow, or else the Barbary stag; both the Caucasian ibex and wild sheep (*Ovis tragalaphus*), oryx, and other species of antelopes, still inhabit the regions bordering on Egypt, and were doubtless found further northwards during the early Pharaonic times.

[2] The wild boar, although a native of the country, is not apparently represented on the monuments, but the domesticated race was common; and the drawings represent a striking likeness to the feral type as seen in the wretched pigs in Eastern cities even at the present day. Possibly, in both instances, in consequence of having been considered unclean, no care was taken in rearing it or in improving the breed.

[3] These were pieces of wood, either of heavy sorts, or weighted at the

shallop moves slowly through the tall papyrus and rushes, his cat is seen retrieving the ducks from the water. By some, this portion of the scene is supposed to have been done for effect, but there are numerous examples of cats having been taught to reclaim lost game; and the Canada lynx is well known to be an expert swimmer, and preys on trout and small fishes.[1] It may have been its utility in the hunting-field and about their houses that gained for the cat such veneration, that whoever killed a cat, either wilfully or by accident, was put to death. Moreover, its attachment to localities may have given rise to the idea of the ancients, that divine agency was displayed when cats were seen entering houses on fire.

The ichneumon is still common in Egypt, and, as in many Eastern countries, is often tamed. We see it introduced into the old hunting pictures; no doubt it was trained to capture wild-fowl.[2] The myth regarding the antidote it is said to have recourse to in a certain plant whenever an individual is bitten by a snake, is believed by the fellahs of Egypt, as well as the natives of India.

The ancient hunting and fowling pictures are often remarkable for their animation and clearness. The fowler in his shallop, with a decoy-duck in the prow, is depicted stealing slowly through the dense masses of bulrush and papyrus plants, and, as the birds rise, he delivers throw-stick after throw-stick at the scared geese, ducks, and other

extremity, which the fowler delivered with great force among flocks of wild-fowl.

[1] Settlers in New Brunswick have assured me that they have watched the lynx so employed, and on the authority of Dr. Caufield, LL.D., Cork, I am informed of a cat that regularly repaired to a brook in Cork County, Ireland, where it was repeatedly observed capturing trouts and small fishes.

[2] I am not aware that it breeds in captivity, but its close ally, *H. griseus*, the Moongus of India, breeds pretty freely, and, although a great rat-killer, is very destructive in poultry-yards.

water-birds, which are seen falling in every direction; nor has the artist contented himself with the mere representation of the sportsman's exploits, but, just as may be observed now-a-days in the fens of the Delta, numerous lepidoptera, dragon-flies, and other insects disturbed by the wild fowl, are fluttering around him. His children hand him spare weapons, and whilst some are picking up the dead birds, others are holding fast by a bush of papyrus in order to steady the boat. The ibis-billed bird, observed in one of the most spirited pictures of this description,[1] is probably not the sacred ibis, for it would have indeed been next to sacrilege, and a violation of the most sacred laws, to have touched a feather of that divine emblem of the great god Thoth—perhaps the curlew or whimbrel that is shown in the above representation, as both are not uncommon along the river's banks. Feats such as the above could scarcely be accomplished now-a-days; doubtless the constant molestation by travellers and steamboats, and the wholesale slaughter by means of punt-guns, have made them very wild. I observed one day an enormous flock of white-fronted geese crowding a sand-bank, many apparently asleep, when suddenly a gun opened fire from a boat which had been pushed silently within easy range, and committed great carnage, not only killing many, but wounding and disabling others, which fell in the fields as the frighted host made off. It may be from constant molestation that the geese on the Nile feed at night, and repair to rest in the distant shallows during the day. As elsewhere observed, the white-fronted was apparently one of the species domesticated by the ancients; but I have seen a drawing on the walls of the temple of Amada, in Nubia, so very like the greylag goose,

[1] Wilkinson, *op. cit.*, vol. iii. p. 41.

that there is some probability that it was also tamed;[1] in the instance in question, it appears among the votive offerings.

VIII.—DESERT BIRDS.

Sand-Grouse.—The sand-grouse rear their young in the desert, and spend the day on the heated sands, repairing at dusk and early morn to the cultivated districts for subsistence. One might imagine, therefore, that incubation was a simple process with them and such-like birds, that merely scratch a hole in the sand and there deposit their eggs. The Isabella-coloured night-jar (*Caprimulgus isabellinus*, Temm.), does the same, and sleeps during the day on the hot sands, scraping a little hollow in which it lies. The most common sand-grouse of Northern Africa, extending far eastward into Asia, is the pintail (*Pterocles exustus*). It has a singed or sandy tinge on its fulvous grey plumage, very characteristic of desert birds, as if the constant sojourn on the blazing sands had acted through generations, and assimilated the outer aspect of the bird to the objects around it. The handsome crowned (*P. coronatus*) and Senegal sand-grouse (*P. senegalensis*) are also natives of the desert wastes of Egypt and southwards. On the plain of Thebes flocks of the first-named grouse frequent the cultivated tracts at dusk and early morn to feed, when the sportsman might bag eight to twelve brace without much trouble. On approach of danger it squats on the ground, and is then extremely difficult to observe. The loud and guttural call of this and other members of the family gain them notoriety. Hence the Egyptians know it by no other name than "gutta." The gastronomic virtues of the sand-grouse are not

[1] The greylag goose is the origin of our present domesticated geese.

remarkable; the flesh is dry, skin very tough, and there is little flavour. The removal of the skin adds apparently to the gustable qualities of these birds, which poorly maintain the character of the Scotch grouse as articles for the table. Rapacious birds excepted, the sand-grouse are the only other birds that are feathered to their toes. One can fancy this provision of nature to be highly beneficial to the snowy owl and ptarmigan, which inhabit very cold regions; but it would almost seem to stand in the way of the sand-grouse, eagles, and owls of warm climates. The same inexplicable inconsistency is presented in the bare-headed vultures and turkey. We can well imagine the benefit a bare head and neck is to a bird that wallows in putridity, but there is seemingly nothing of the sort obtains in the case of the turkey. It is strange to observe likewise that many appendages apparently furnished for the animal's welfare are not altogether adapted to its habits,—as examples; the rook's bristles on the upper mandible are removed invariably by the end of the first winter by dint of digging, and in the case of the sand-grouse their constant habit of squatting removes the feathers from the back part of the leg, and the bearded vulture is given to the same habit on the craggy shelves of the Himalayas, so that, although the young birds are fully feathered to the toes, there are few old ones that have not the posterior surface of the tarsus naked.

Desert Chats.—Of the many attractive desert birds of the country, there are certain chats which prefer a sort of half-civilized, half-savage life, and pick up a scanty subsistence along the margin of the inundation, and delight to sport among the crumbling walls and crude brick ruins. One of the most captivating is the white-headed chat (*Dromolœa leu-*

cocephala), at once recognised by its jet black body and pure white head and rump. In the same situations are seen the white-rumped (*D. leucopygia*) and pied wheatears (*Saxicola leucomela*). The former is entirely black, excepting the rump and tail, which are nearly pure white. The latter has a snow-white crown, breast, belly, and rump, the remainder of the body and tip of the tail being black. All average about 6½ inches in length, with similar habits and haunts, their graceful forms and purity of colouring contrasting with the sombre hues around. The wheatear (*S. œnanthe*), common and black (*Rutcilla phœnicura et tithys*) redstarts, take up their residence in Egypt and Nubia during winter, associating with the chats just described. A solitary Norfolk plover (*Œdicnemus crepitans*) is sometimes met with in the same situations, but chiefly on the stony wastes of the Nubian plateaus along the river's banks. At night its cry is often heard in consort with that of the jackal, and sometimes its form, spectre-like, flits pasts the traveller at midnight, and soon afterwards he is startled by its wild flute-note, "*turrluee turrluee*," sounding across the desert. The Isabella-coloured wheatear (*Saxicola isabellina*) is plentifully distributed over desert tracts, and in outward appearance, as in habits, bears a close resemblance to the European *S. œnanthe*. There is a little pallid-coloured desert chat (*S. pallida*) often seen on the plains and on the desert. Its plumage is pale sandy, and flight rapid, during which it may be observed catching insects. Allied to these is the handsome desert wheatear (*S. deserti*); the russet of the upper parts, black throat and wings, suffice to distinguish it from the others, excepting the russet wheatear (*S. stapazina*), which is not nearly so common.

Of all the feathered denizens of the wilderness recom-

mend me to the courier (*Cursorius europæus*). This swift-footed tenant of the arid plain is usually met with in flocks, pursuing insects on foot; now digging its awl-shaped bill into the hard baked soil; now stopping for a moment and jerking its head backwards; anon off at full speed for some twenty feet at a racing pace. The flesh is pale and delicate, but, like many of its congeners, is not savoury.

The desert lark and larkfinches are represented in these countries by several characteristic species. There is the desert lark (*Certhilauda desertorum*), of wide Eastern distribution; it is about nine inches in length, of a light Isabella colour above, and white below. It may be seen around the Pyramids, and along the margin of the desert, running at great speed, with a very erect carriage, stopping at every few yards as it speeds its way along the sandy plain. There is the Isabella lark (*Galerida isabellina*), a few inches smaller, and readily distinguished on wing for the transparency of its pale-coloured quills and general fulvous hue of its plumage.

Besides the above, the little bush-lark and the pale desert-lark (*Mirafra cordofanica et Ammomanes pallida*), known by their short stout bills; both are met with in flocks on the Nubian wastes.

IX.—THE SACRED IBIS.

Among all the birds of Egypt and Nubia, none has attained to the celebrity of the sacred ibis. There is good evidence to show that this bird was very common up to and even subsequent to the Roman conquest, and overthrow of the religious observances in which it held an exalted position; for, besides the enormous numbers of mummied bodies

of this bird met with in tombs, there are the assertions of the ancient historians to prove that it wandered about unmolested in towns and over the country, and was common in Egypt up to the first and second centuries of the Christian era, and was carried by the Roman conquerors to the temples of the capital, and also the chief cities of the Empire. How long it lingered in Egypt and Italy we have no reliable information. It appears on the walls of Pompeii, and is mentioned by historians as honouring the temple of Isis by its presence. In fact, from the dawn of civilisation in Egypt up to the decline of the Roman Empire, it was considered among the sacred animals, and was reverenced and respected not only by the ancient race, but also their European conquerors. The place occupied by the ibis in the religious worship of the Egyptians testifies to the high repute wherewith it was held by this people, being the emblem of Thoth, the scribe or secretary of Osiris, whose duty it was to recount the good and bad actions of the souls of the deceased when ushered into the presence of the god. There are notices in the writings of several modern naturalists, that the bird is still occasionally to be seen on Lake Menzaleh, in the Delta; but all my inquiries failed to substantiate this assertion, which, it seems, was originally made by the naturalist M. Savigny, who accompanied Napoleon I. to Egypt in 1800. I shall now proceed to define its present habitats, as far as I have been enabled to discover. It was observed by Bruce in Abyssinia, and lately by Heuglin[1] on the coast of the Red Sea, and the latter country. Vierthaler[2] found it abundant during the inundation in July at the junction of the Blue and White Niles, where it breeds. So much for its present geographical distribution, as regards the neigh-

[1] *The Ibis*, vol. i. p. 347. [2] *Naumannia*, 1852, p. 58.

bourhood of its ancient haunts, and as far as our present knowledge extends. No doubt, when its extension eastward is known, we will in time be enabled to determine whether the white ibis of India (*I. bengala*) is merely a local variety of the sacred bird. The former differs only in shades of plumage, especially on the back. As regards the length and size of the bills of both, I have shown[1] that individuals of the mummies of Egypt even exceed in length the largest of the Bengal ibis, which is stated by Jerdon[2] to present a stronger organ than the other. According to Vierthaler, the flesh of the ibis is savoury and tender, and, when well prepared, is a great dainty. This peculiarity presents a marked contrast to the Oriental ibis, the flesh of which, according to all accounts, is extremely coarse and unpalatable. The eggs of the Asiatic bird are white, faintly blotched with rust colour, and agree with those of the sacred ibis, found in tombs and in its modern habitats, to be noticed presently. All the mummied specimens of the bird represent the species in question, and also the paintings and sculptures on the monuments; but although Herodotus's accounts of another ibis are vague, and possibly from hearsay, still, remarking that it was smaller in size, and of a black colour all over,[3] we may pretty correctly surmise he is referring to the glossy ibis, which is common in North Africa, and migrates to Europe. I am not aware that mummies of the latter have been found, nor do the paintings I have seen represent a bird at all like it. I collected upwards of a hundred embalmed bodies of the sacred ibis, with the view of substantiating the assertion that it was reverenced by the ancients chiefly for its great use in destroying small reptiles, and other noxious creatures

[1] *Edinburgh New Philosophical Journal*, vol. xix. p. 173.
[2] *Birds of India*, vol. iii. p. 768.
[3] *Euterpi*, i. 74.

which infested the country. One unrolled by Cuvier contained fragments of a snake, but all examined by me, and subsequently forwarded to Sir William Jardine, showed no trace of reptiles in the contents of their stomachs, which were filled with fragments of small fishes, land and fresh-water shells,[1] and much undeterminable carbonaceous matter, besides abundance of insects, some known to still inhabit the Nile Valley, others not recorded in published lists of its fauna. In the contents of the stomach of one specimen, Mr. Andrew Murray[2] discovered a fragment of the *Ateuchus sacer*, which I observed is still plentiful throughout the country. It is probable, however, that although not partial to snakes and reptiles, it never passed the smaller ones by unmolested; for, although the edges of the bill of the ibis are not well adapted for the quick despatch of such, still, like other waders known to feed on small reptiles, it may have seized its victim by the neck and killed it by suffocation, and repeated blows on the ground. Insects seem to have been its favourite food; several pebbles were found in their stomachs, and the small oblong blue bead, so much used to form bracelets and necklaces, and usually observed on the human mummies, was discovered in the stomach of one unrolled by me.

It is curious to observe the care with which the process of mummification was conducted. In the case of the ibis, after bedaubing the outer surface with bitumen, the tips of the wings were twisted together, the legs bent and placed

[1] The principal shell in the stomach of the ibis was *Paludina bulimoides*. This was submitted to Dr. Baird of the British Museum, and was found precisely identical with the species at present existing in the Nile, and exhibits no difference from the species existing through a term of at least 3000 years.

[2] *Edinburgh New Philosophical Journal*, vol. xix. note, p. 181.

on the front and sides of the abdomen, whilst the head was brought down so as to lie on the breast. The object evidently was to arrange the specimen in a way that would admit of being easily placed in the earthen jar, the mouth of which was sealed up, and when the mummy was placed in a pit among others of the same description. Sometimes the body was swathed in mummy-clothes, more especially when not preserved in jars, as is the case in many ibis pits at Thebes. The preserving substance was injected through an aperture in the abdomen, and also into the stomach by the mouth. I have often unrolled a mass of bandage, and found only a wing or leg of an ibis.

Whether the ibis was at one time indigenous to Egypt or not, we are unable to discover; at all events, it is highly improbable that the bird was migratory in that country. There could have been no difficulty in procuring individuals from the shores of the Red Sea; and to a people so well practised in taming wild animals, we may conclude that it was soon domesticated, and bred freely; moreover, like the white ibis of India, which usually lays from four to five eggs, we can easily suppose that the numbers rapidly increased. On the contrary, when its protectors vanished from the land, so did the ibis. One can fancy such a picture as that which forms the frontispice to the admirable scientific magazine which bears its name;[1] indeed, we might easily imagine such a scene occurring long after the overthrow of the monuments where the bird had been carefully fed and cared for, and under the shelter of which it had been in the habit of retiring from the nipping cold of winter.[2]

The gaunt form of the ibis, singly or in groups, standing

[1] *The Ibis: a Magazine of General Ornithology.*

[2] I have seen a hoarfrost at sunrise on the plain of Thebes.

pensively on the shattered columns of the noble temple of Karnak, and gazing downwards on the fallen grandeur which in happier days welcomed the mightiest of the Pharaohs—a cloudless sky—the glowing sunset and placid Nile—the desolation of Thebes beyond, where nought now remained but its crude and crumbling walls, and that Memnon and his companion, scarred and defaced by the hand of the destroyer, seated austere and solitary in the vast field of ruin, whilst the frowning cliffs of Libya, in the background, look down in solemn dignity on all those remnants of former magnificence;—I can imagine few more impressive studies, and to no one more enchanting than to the landscape-painter.

X.—DOMESTICATED CATTLE OF THE PHARAOHS.

THE domesticated cattle reared by the ancient Egyptians evidently composed several highly improved breeds, which have long since entirely disappeared from the country. The magnificent long-horned ox, now extinct, is still found in Abyssinia, however. A smaller short-horn, perhaps the progenitor of the small degenerate race of the moderns, and the humped or Brahmin bull, seem to have been domesticated on the banks of the Nile at least 2000 years B.C. The buffalo,[1] now fast displacing the short-horn of the country, has lately come from the East, and was not seemingly known to the ancients; and perhaps the sacred animal of the Hindus may have found its way to Egypt in the Pharaonic times from the East, and finally to Abyssinia and Ethiopia, where it is said to exist at the present day. The variety

[1] This breed is better adapted for the summer climate, being sparingly covered with hair, and much addicted to wallow in the river during the heat of the day.

and excellence of the breed of Egyptian cattle seem to have continued even during the Greek and Roman occupation, and up to the complete overthrow of the religion, in which the animal occupied a very prominent part. This is abundantly manifest, not only from profane and religious history, but also on the monumental pictures and rude sketches in the quarries and on rocks all over the country. It has been frequently remarked by antiquarians, that although the domestic fowl abounded in Egypt, it is not apparently represented on the sculptures, or been found embalmed. White and saffron-coloured races are mentioned equivalent to existing kinds.

Now, when we think of the varieties of cattle, horses, dogs, pigeons, and poultry in the possession of this people between forty and fifty centuries ago, and consider that it requires generations and much selection before many coloured pigeons, cattle, dogs, etc., can be produced; therefore how many hundreds or thousands of years preceding were there consumed in bringing the wild originals into this state of domestication? Nothing speaks more for the antiquity of the Egyptians and their state of civilisation than the manner they selected wild animals and reduced them to subjection. The lasso was a favourite mode of capturing the gazelle, wild sheep, and some pictures represent long-horned oxen being caught in this manner. These, however, were probably unruly animals, which had wandered, away from their owners or the temples, where, like the humped bull of the Hindus, they were free to roam wherever they chose. The numerous delineations seem to indicate, that in these old-world times not only were the animals more numerous, but, as might be expected, far less wary than at present. The throw-stick would do small execu-

tion now in the fens of the Delta, and the lasso would be of no use in the capture of any of the wild quadrupeds. Indeed, so much is this the case as regards the gazelle, that although almost daily accustomed to see herds on the Nubian desert, I could not, with all the tact of one experienced in deer-stalking, manage to get within several hundred yards of them. It is, however, a pretty sight to watch a herd flying like the wind along the sandy plain. I have stood and admired herd upon herd of antelopes bounding along the desert at sunset, their long dark shadows appearing like phantoms chasing them, and presently, as they approached the cultivated tracts, there would be a dead halt, when, breaking up into small detachments, they would cautiously draw towards the fields, the colour of their fur and stealthy movements often rendering them undiscernible at the distance of a few hundred yards. It would appear, as is the custom at the present day in many parts of Central Asia, that the favourite mode of hunting was by surrounding the animals in ravines, or capturing them in situations where the herd had no ready means of escape.

XI.—LION, PANTHER, AND LEOPARD.

THE lion roamed, in all probability, over the Egyptian deserts at one time or other, during the civilisation of the ancient race, and no doubt the same may be said of the panther, leopard, and serval, all now more or less repelled to Central and Southern Africa. On Beni Hassan's walls there are vivid pictures of tamed lions capturing wild sheep. As regards the three others, they appear as tribute and presents brought by foreign nations to the Pharaohs; but doubtless they were also used in hunting. It is worthy of notice that vast quantities of the remains of the three last

named have been discovered along the shores of the Mediterranean,[1] and although in a fossil state, still, I repeat, it may be possible that all existed in Egypt or in its immediate vicinity during periods of the monumental history. The lion is still found in Southern Nubia, from whence many of the inmates of menageries are obtained. I spent several days on board a Nile boat, in which four lion-cubs were being conveyed to Cairo. They had been captured in Darfur only a short time previously. They seemed as playful as kittens, running about the deck, and following their owner from place to place. One afternoon a crash of plates and crockery drew us below, when it was discovered that the largest cub had stolen a leg of mutton, and was intently devouring it on his master's bed, and for the first time showed temper by tearing the counterpane with its claws when the food was removed. This individual I learned subsequently became ungovernable, and required continued restraint and application of the corbash. A tamed chetah belonging to a friend of mine in India was discovered gnawing his slipper, and on being beaten ran from the house. A few minutes afterwards, whilst its master was seated in his bedroom, the infuriated animal dashed through the window-glass at one bound, and, alighting on his bed, tore the pillow to pieces. It had always been docile and obedient up to this time, but now as if the natural passions of the brute, hitherto restrained through kindness, had suddenly broken forth, and were no longer to be kept in check, for subsequently, and on any attempts to thwart it in its desires, there were manifestations of anger which finally necessitated its destruction. No doubt the ferocious propensities of the

[1] Falconer and Busk on the Fossil Contents of the Genista Cave, Gibraltar.—*Quart. Jour. Geol. Soc. London*, vol. xxi. p. 364.

feline race may be overcome by constant interbreeding, and probably thus the lions of the ancient Egyptians attained their docility through generations of domesticated individuals. The lion represented in the animal writings "courage and strength," its fore-parts the "rising of the Nile,"—all most appropriate significations.

Hyæna.—The striped hyæna is often represented on the monuments, and is to this day a native of the country. It is said to feed on Indian corn, and be destructive to the crops. This seems peculiar in so carnivorous an animal. Much has been said regarding its ferocity, but every one who has seen the hyæna in its native haunts, knows that few of its race are more cowardly. It is easily domesticated, and, if reared with care, turns docile and attached to its keeper. The spotted and brown hyænas may also have existed in Egypt within its historical period. The former frequents the districts south of Nubia, and, although the latter is not reputed to inhabit any portion of the continent north of the equator, still the presence of the remains of both in a fossil state having been discovered in Southern Europe, render the opinion probable that the animal has been repelled to its present habitat. Remains of the *H. crocuta* were found by Baron Anca in the caves of Palermo, along with fossil exuviæ of the *Ursus arctos*, wolf and fox.[1]

City of Wolves.—The so-called wolves' teeth found charred and preserved in the celebrated caves of Lycopolis, seem to belong to different species. I collected many teeth, all of which were referable to the fox or jackal, both

[1] *Bulletin de la Société Géologique de la France*, 2 Series, t. xvii. p. 884.

of which are plentiful in the country at the present day. It has been surmised that the ideal of the dog-headed god Anubis, in particular the square-eared animal of the olden pictures, sitting on its haunches with erect tail and ears, was the Abyssinian fennec, so remarkable for its long ears, whilst the sculptures and drawings of later dynasties look more like the jackal.

XII.—THE HIPPOPOTAMUS, RECENT AND FOSSIL.

On the walls of the magnificent temple of Edfoo (perhaps the most perfect of all the Egyptian ruins) are sculptured several strange and remarkable representatives in connexion with hunting scenes. One in particular is the ancient mode of spearing the hippopotamus. Similar scenes are vividly depicted in various other monuments. As is the custom at the present day among the savage races of Central Africa, it seems to have been a favourite occupation to capture the animal—no doubt as with them the flesh was in repute, and its hide in request for making shields, etc. Now-a-days, and for several centuries, the river-horse has seldom been found below the entrance of the Atbara and Blue Nile. It at one time abounded in the Delta, and in geological times was spread over Europe; the larger form [1] inhabiting the northern portion, whilst a smaller race (*H. pentlandi*) seems to have lived in the south of France, Italy, Malta, Sicily, Candia, etc.

There is little difficulty in recognising the teeth of each of the two sorts by peculiarities in form, and the larger dimensions of the *H. major* of Northern Europe were supposed to be characteristic of that species independent of the

[1] The so-called *H. major* of Cuvier.

form of the tooth, but when visiting the temple of Kalabshee in Nubia, I was surprised one morning by a native showing me a fragment of a fossil jaw, containing the two last upper molars of what appeared to have belonged to an enormous river-horse. The Arab who gave me the specimen was unfortunately not the individual who found it; but he assured me that it had been dug out of the river alluvium on which the temple stands, and at a spot where excavations had been made in quest of antiquities. I sent the specimen to England, where it was examined by Dr. Falconer, who has shown[1] that it represented an animal as large as any fossil species; thus establishing the fact, that although there are some discrepancies with reference to configuration of the teeth, there has existed in the Nile individuals of the *H. amphibius* equal in size to the largest specimens of *H. major*. But among the living river-horses of Africa there are large and small races,[2] as we find among the extinct fossil species; thus, probably, like the hyæna, lion, and other large animals, the hippopotamuses of equatorial

[1] Of the dimensions of the molar teeth referred to Dr. Falconer writes, "The molar teeth present the ordinary characters of the existing hippopotamus of the upper part of the Nile Valley and Senegal, but in size they equal those of the great extinct form of Europe, *H. major* of Cuvier." Compared with specimens of the latter in the British Museum, those from Kalabshee yielded measurements as follows:—

	H. major, No. 28,790, British Museum.	Kalabshee specimen.
	in.	in.
Length of penultimate molar, . .	2·0	2·25
Width of do., . . .	2·2	2·2
Length of last molar, . . .	2·1	2·2
Width of do., . . .	2·15	2·15

Dr. F. failed to detect any diagnostic characters which would justify the separation of the Kalabshee specimen from the Senegal variety of the living *H. amphibius*.—*Quart. Jour. Geol. Society*, vol. xxi. p. 373.

[2] Falconer, *op. cit.*

Africa[1] may be the same species that once inhabited Europe, but have been repelled to their present homes through mutations in the earth's surface, climate, and man. I visited many natural caverns in the limestone and sandstone formations of both Egypt and Nubia, hoping to find (as in other countries) fossil remains of their former occupants; and although abundance of recent bones of sheep, asses, oxen, and such like, strewed the floors, and bore traces of having been recently gnawed by hyænas, jackals, foxes, and other predaceous animals, there were however no calcareous dripping or deposit to cover them up, as would be the case had there been a regular annual rain-fall, so that none of these remains are likely to be preserved for any great length of time. Supposing, therefore, the same conditions to have existed during far-back epochs, there would not be much chance of finding any fossil remains of the times. The geologist, however, is free to speculate on periods when the climate of Nubia was different from what it is at present, and may, at all events, admit such phenomena as exponents of geological occurrences of a similar character under more favourable circumstances than what prevail at the present day in Egypt and northwards.

Colouring of the Plumage of Desert Birds.—The colour of the plumage of many desert-loving birds, like the denizens of arctic regions, assimilates to that of surrounding objects, and, moreover, as has been truly said, we also find the bleaching influence of the desert, and the dry and cloudless climate,

[1] *Hippopotamus senegalensis*—Desm., which seems to be the same as one subsequently described by Dr. Morton, and named *H. Liberiensis* of St. Paul's River, Western Africa; perhaps after all, like the elephant, they will turn out mere local varieties of one species.

imparting their hues to the Egyptian monuments. So much is the latter the case, that the eye fails at first to receive an impression of their immense antiquity, owing to the absence of the grey colouring and weather stains which give so venerable an aspect to those of Northern Europe. There is thus a stamp imprinted on all the animate and inanimate objects, in accordance with their haunts,—as, for example, the desert chats and other birds are much paler in colouring than those which frequent the cultivated districts on the river's banks. There are, however, exceptions; but the rule seems pretty general everywhere. The effects of food and climate in determining the numbers, or in changing the colour, size, and appearances of animals, are perhaps far greater than many naturalists suppose. We know the effects of food on domesticated races, but are unable as yet to determine how far mutation in the physical aspect and climates during geological epochs may have influenced the flora and fauna of any one region. The pied wheat-ear (*Saxicola lugens*) of Egypt has the feathers of the vent a pale russet, whereas the individuals met with in the Crimea and Eastern countries have the same part white. I have pointed out (page 11) the colouring which distinguishes the chimney swallow of Egypt and that of Europe. The stone chat (*Pratincola rubicola*) which visits Egypt in winter has more dull red on the rump and throat than the English bird. Many species seem affected as to size by climates. We find the jackal larger in the temperate regions of the Himalayas than on the hot plains of Hindustan; and many other species indigenous to these two very distinct regions participate in exactly similar conditions. Indeed, it would appear that every living object has a select climate and region where it attains its maximum vigour. I do not suppose any one

competent to form an opinion on the subject believes that the Anglo-Saxon on the one hand, and the Negro on the other, are adapted for climates diametrically opposite to their own native countries.

Deterioration of Race.—The white man may live under the equator, but his race will deteriorate; indeed, it is evident he has no more pliability of constitution than other omnivorous animals, and go where he may to climates essentially different from his own, unless by constant infusion of fresh blood, there will, in a few generations, take place a deterioration of race so marked that time seems only requisite to bring about entire extinction. We have only to observe the effects of small transitions of climate on the Saxon-born Americans, as pointed out by many competent authorities, such as Drs. Knox and Carpenter,[1] who positively assert that the Saxon race could not stand their ground were it not for the continuous infusion of fresh blood from Europe; indeed, the latter[2] goes further, and makes the extraordinary and startling remark, that the genuine Yankee is gradually assuming the cranial characteristics of the Red Indian. There is no reason, therefore, to withhold the belief that similar causes would not produce corresponding effects on wild animals; hence modifications through some process or other of natural selection may, during the unrecorded ages (which geologists recognise), have eventuated in characters so divergent, that many animals we are in the habit of considering species may be but the offshoots of extinct forms. The divergences of types, so as to produce varieties, and even species, might be illustrated in the case of

[1] *Races of Men*, pp. 44, 57.

[2] Todd's *Cyc. of Anatomy and Physiology*, p. 1330.

the extinct hippopotamuses of Europe, Italy, and Algeria, as shown in their representatives of the present day in Africa, where, as in the case of the former, we find large and small races of river-horses frequenting different localities. Now, allowing that there are pretty regular distinctions to be drawn between the fossil and recent animals, but only in respect to their odontographies, is it possible or not, by allowing time as the important factor, and conditions of life as a second cause, that through natural selection the present denizens of the African rivers are the descendants of the great fossil *H. major* and *H. pentlandi* of the quaternary deposits of Europe?

XIII.—CROCODILE AND BLACK-HEADED PLOVER.

THE crocodile seems, like the hippopotamus, to have at one time infested the Nile, from its mouth to its sources. The animal is now rarely seen below Beni Hassan, and is evidently receding everywhere below the second cataract; indeed, it is surprising that any exist northwards of Asowan, for, independent of the constant traffic by river-steamers and sailing-boats, few of the hundreds of travellers who annually traverse the river lose an opportunity of molesting the brute. I can well believe the statements of Herodotus[1] and Strabo with reference to the domestication of the animal, seeing that it is reclaimed at the present day by certain religious sects in India,[2] and rendered so tame that it leaves its pond and feeds out of the keeper's hands. Far different is this now the case on the Nile, where, unless in secluded reaches, it is scarcely possible to get within rifle-shot of the

[1] *Euterpe*, ii. 68.

[2] *Wanderings of a Naturalist in India*, p. 41.

monster. A sail, or the smoke and noise of a steamboat, suffice to warn those basking on the sand-banks, or their common companion, the black-headed and spur-winged plovers (*Pluvianus ægyptius et Hoplopterus spinosus*), which are frequently seen perched on their backs, and always prepared to give timely warning of approaching danger, just as the Father of History[1] noticed them 2300 years ago, and, strange to say, his well-known story is current among the modern Egyptians, who, as usual, have put a tail to the narrative. They say, that in addition to its office of leech-catcher to the crocodile, it occasionally does happen that the zic-zac (وزتذاق)—so called from its note of alarm,—in searching for the leeches, finds its way into the reptile's mouth when the latter is basking on a sand-bank, where it lies generally with the jaws wide apart. Now this is possible, and likely enough, but the captain of our boat added, that occasionally the crocodile falls asleep, when the jaws suddenly fall, and the zic-zac is shut up in the mouth, when it immediately prods the crocodile with its horny spurs, as if refreshing the memory of his reptilian majesty, who opens his jaws and sets his favourite leech-catcher at liberty. The advantage of spurs on the wings of this and other members of its family is not clear, and, being common to the sexes, is against any particular defensive use. Although the points of the spur become more acuminated during the breeding season, it has not been remarked that this bird is more pugilistic then than at other times; indeed, all species so armed seem to lead unusually quiet lives as compared with other allied plovers. The above is generally observed in pairs. Like the lapwing (*Vanellus cristatus*), it is noisome and garrulous. The zic-zac in consequence gains notoriety

[1] The *H. spinosus* is undoubtedly the *Trochilos* of Herodotus, b. i. 68.

with the Nile voyagers, as it stands on a sand-bank jerking its tail up and down. A more unwelcome arrival to the sportsman can scarcely be imagined than one of these birds. Just as he is stealing on a flock of wild-fowl it rises up, and, flying around him, gives utterance to its well-known cries, always a sure warning of approaching danger. An Arab who had been long in the habit of shooting crocodiles and preparing their bodies for sale, informed me that he only managed to obtain them when shot through the brain, as a bullet in any other part of the animal's body was never immediately fatal, so that the crocodile could gain the river, dive, and hide itself on the bottom before his arrival. The fatal spot is on the hind head, behind the ear. I shot one in this situation, the bullet passing through the lower and hind portion of the brain, when the animal rushed into the water, then ran backwards, keeping constantly moving in the last direction, such as has been observed in quadrupeds and birds wounded in the same situation. I did not observe, however, the convulsive movements of the limbs usually noticed in higher and more perfectly constructed organisms. It is seldom crocodiles attack persons in the river, perhaps for the reason that they have been much molested. Cases, however, are recorded, and the above-mentioned hunter assured me that he had often opened the stomachs of the large individuals in quest of the silver amulets, rings, and such-like, worn by the native women, and assured us of more than one instance where silver ornaments had been discovered. I can quite fancy such an occurrence possible, from the fact that the reptile often bolts its food without the slightest attempt at mastication.

XIV.—SACRED BEETLES.

THE veneration wherewith certain sorts of scarab beetles were held by those old-world folks, have induced some antiquarians to suppose that their stone representatives now so much in vogue were used as money; but whether or not, to an observing people like the ancient Egyptians, it must have been a sight for contemplation to witness these insects rolling their pellets from the dank slimy margin of the retiring river.[1] Even to this day, during the cold months, one may come on some spot where thirty or forty of these creatures with Sisyphian perseverance are

> "Trying to get it up aboon the knowe,
> Wi' baith his han's and baith his feet; but wow!
> When it 's maist deen, back wi' an awfu' dird,
> Doun stots the stane, and thumps among the yerd."

In such a situation as mayhap was the case 4000 or 5000 years ago, stands perched on the tall beams used for raising water a little hawk, which the ornithologist at once recognises as the well-known kestrel (*F. tinnunculus*). Now, it was also one of the sacred animals of the ancients; but what were they thinking about in choosing this little plunderer, who makes a livelihood by devouring their beloved scarab, the sacred emblem of the "Sun and World"?

Touching scarabs and their stone representatives, the following rather amusing incident came to my notice during our sojourn in Upper Egypt. A certain individual, who shall be nameless, called on Mr. Rhind, to make the acquaintance

[1] It is well known to entomologists that many species of dung-feeding beetles lose their feet from some cause or other. I have wondered if this would result from the great exertions required in rolling the pellets. In the species here referred to, and in particular the *Ateuchus sacer*, they are totally deficient,—at all events in adults.

of a brother Egyptologist. This "smart man," as he would be called in his own country, was in the habit of paying regular visits to every boat containing white faces. He gave it out (and perhaps he was stating facts) that he had come across the Atlantic, and settled down in the land of the Pharaohs for the purpose of devoting his entire attention to the study of the hieroglyphic writings. Now, this person was on bad terms with his landlord, and after talking over some intricate points, in which Birch of the British Museum had differed from the German translators, and such-like difficult questions in connection with the construction of the mysterious language, our visitor changed the subject, and informed my friend that having finished the study of many antiquities, papyri, and so forth, in his possession, he would, (*sic*) "to oblige a brother student of ancient lore," let him have whatever he chose, at the exact same price originally paid by their present possessor. Indeed, he said he was afraid to keep them, being the only Christian in the town; moreover, he had been constantly annoyed by the natives, and even his life threatened, unless he left the society of the "true believers;" even his landlord had proceeded to eject him, but he took the law in his own hands, and "go, he would not!" The result was an attempt at assassination, which, however, eventuated only in somebody having been seen at night before the student's window brandishing a cutlass. The above story, as told to us by the excited narrator, wore very much the aspect of what seemed religious intolerance and persecution, examples of which are still not uncommon among Christians as well as Mussulmans in many semi-civilized countries, and wherever one or other happens to predominate. We therefore extended considerable commiseration towards our visitor, and by way of comforting him, purchased

several of his scarabæi, etc., after which he took his departure. It was ten P.M. when the Egyptologist withdrew, and we were making preparations for bed, when the cabin-door opened, and who should glide into our presence but our late visitor's landlord! Mustapha was this Ethiopian's name—a good-natured, obliging man, who knew a little English, and was a stanch and ardent friend of Mr. Rhind. He had dogged his tenant to our boat, and most probably overheard all he had told us. With excitement vividly depicted on his sable face, "I come," said he, "to warn you against Mr. Smid." "Mr. S.," he went on to say, flashing his eyes Othello-like, "make scarabæi; he shut his door and tell no one, but I look through a hole, and see him file and polish sometimes all night. He make little idols and rings, and sell them to the Howagee (traveller or trader) who come up the river. I tell him this one day; he get angry. I tell him leave my house; he not go." This set my friend to examine his purchases, when, to his disgust, he found not one of the works of art was real, but so closely counterfeited as not to be known from the original except by a connoisseur. There was a cunning native blacksmith at Thebes who fabricated antiquities to please the unlearned, but this specimen of erudition, and of all others, Egyptian learning, in combination with handicraft, is rare indeed. How far the learning was a blind to secure good-paying customers, and as a means of introduction to unsuspecting antiquarians, did not appear, as our friendship with him ceased from that day.

XV.—PHYSICAL ASPECT OF NUBIA.

THE physical aspect of Nubia between the two lowermost cataracts differs widely from Egypt, the soft siliceous sandstone being more destructible than the nummulitic lime-

stone of the low country; but viewed from the river, there is little inviting, and a closer observation disappoints the geologist. Vast desert plains, formed of shifting beds of sand, are broken here and there by sheer cliffs, whilst isolated conical hills and plateaus, several hundred feet in height, break the eternal sameness and wearisome aspect of the scenery, nowhere attractive, save perhaps at little nooks and corners along the banks. The bedding or stratification of this sandstone is perfectly horizontal, and can be traced along cliff-sections in unbroken lines for miles. There are few faults or rents in the rock, showing that its upheaval may have been slow and regular, whilst the isolated conical hills and deep gorges and ravines testify to the enormous degradation and denudation of the surface still going on, as is well accounted for by the vast thickness of the sand and débris around.

Geological Formation of Nubia.—The Nubian sandstone presents the following lithological characters:—It is either a reddish-white or fawn-coloured rock, in proportion to the amount of iron and particles of porphyry it may contain, besides quartzose felspar, and the other constituents of granite and syenite, from which the rock was doubtless derived. The component ingredients of the sandstone vary considerably—usually what might be called a fine-grained rock, which was in repute with the ancients, and worked extensively in their famous quarries of Silsilis; quartz pebbles, in the form of thick layers of conglomerate, characterize the lower part of this formation, where it rests on the granitic beds.

Thus, by the process of degradation, the plains become covered with pebbles,[1] whilst the fine sand which formed

[1] Several fine forms of quartz are plentiful, such as rock-crystals and

their uniting matrix is the sport of the winds, and is being carried far and wide across the vast deserts, or blown into the river, there to mix with the mud in solution, and be conveyed southwards to fertilize Egypt, or be deposited in the Mediterranean.[1] Thus it is not altogether to the sediments borne down from Abyssinia that the fertility of Egypt is owing, for one has only to observe the constant degradation taking place in Nubia and Upper Egypt, and attempt to estimate the amount of tear and wear exemplified by the isolated conical hills of Nubia and the intervening gaps, to realize the belief that the contribution towards the fertility of the low country made by deposits received throughout this portion of the river's course, is far greater than has been supposed; moreover, the fury and violence of storms, although not common or regular, are remarkable for the amount of detritus they convey down gorges into the river, as is seen in the great heaps of soil at the debouchures of the water-courses. Even the nummulitic limestone, although not so perishable as the former, crumbles up and is blown into the river, especially in Upper Egypt, where, as for example at Beni Hassan, cliffs composed almost entirely of nummulites and other fossils are seen intimately mingled with the river alluvium, and being conveyed downwards by the currents. Thus the fauna of the Eocene epoch are being embedded side by side with the fresh-water and land animals of the present day. Sections of the Nile mud vary considerably. Sometimes layers of sand alternate with stratified mud, and

agates. The zigzag, fortification, ruin, and riband varieties, are common on the desert.

[1] I could indicate the presence of the Nile waters when five miles off Alexandria, and the engineer of the Peninsular and Oriental Company's vessel Uxine, assured me that the change of colour during the height of the inundation can be observed forty miles distant.

here and there, for long distances, may be observed seams of the latter highly impregnated with bog-iron, which is seen oozing out along the river's bank, from a short way above Thebes, towards the temple of Edfoo. I have been struck by the circumstance that very few shells or organic remains are observable in the more recent mud along the river's banks, as compared with the ancient fluviatile alluvium on the plateaus; moreover, I spent many hours in examining perpendicular sections of the former, and did not even meet with a fragment of a shell, which may be owing to the circumstance that, unless where currents exist, the general deposit now going on below the cataracts is very slow, and not rapid enough to cover up organic remains, at all events such animals as the crocodile and fishes.

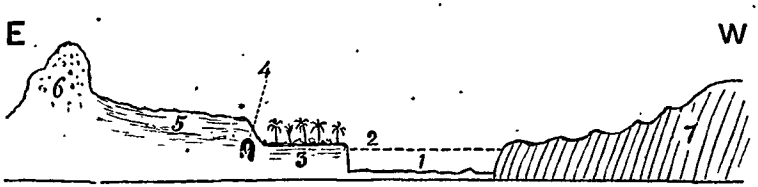
XVI.—ELEVATION OF EGYPT AND NORTH AFRICA DURING PAST GEOLOGICAL EPOCHS.

THE discovery of the common cockle and other marine shells far inland, and over vast tracts of Algeria and the desert of the Sahara, even up to heights of more than 900 feet above the present level of the Mediterranean, and at depths of 300 feet below it, fully establishes the fact that a large portion of North Africa was at no very distant period covered by the ocean; moreover, that the highlands of Algeria, Tunis, Morocco, and Barbary, were at this period separated from Africa by sea, and that the submergence occurred during the modern or post-tertiary period. Further researches have also proved that the same description of phenomena are to be observed along the borders of the Red Sea.[1] A question therefore

[1] See Sir C. Lyell's Inaugural Address at the opening of the British Association, 1864, and his *Elements of Geology*, 6th edition, p. 175.

suggested itself to me in 1863, whether or not Egypt and Nubia had participated in the same continental movements? Accordingly, no opportunities were omitted during our short sojourn in Lower Egypt in searching for similar evidences of upheaval and depression; but owing to the flatness of the country, drifting of the desert sands, and great expanse of cultivation on the river's banks, and our rapid movements, I was unable to discover any traces. It was not until we approached the frontiers of Nubia, and passed the first cataract, that favourable opportunities were presented. The Nile, now contracted by the porphyritic and sandstone rocks, flows between steep banks, and, excepting accumulations of alluvium at bendings and openings in its course, the desert may be said to come down to its margin.

Discovery of Traces of Upheaval and Depression in Nubia. —Wherever these Nile deposits exist, there may be seen clusters of date and doom palms, and fields, whilst further back stand the mud-built villages of the natives; and still more inland are observed plateaus and terraces at variable levels, covered with finely rounded and angular stones and



Section of the Nile Valley at Der in Nubia.

drifted sand. These terrace cliffs continue, with broken intervals, from below the first cataract up to the extreme point attained by us at the top of the second cataract. The observer may have some difficulty at first in tracing these river terraces, but after a little experience, there will be

no trouble in making them out. Let him proceed from the river (1) across the alluvial plain (3), on which stands Der, the capital of Nubia, to the ruined temple (4) of Rameses the Great,[1] on the verge of the cultivated tract; then mount the plateau immediately above (5), and wander inland until he gains a height of 130 feet above the highest mark of the inundation (2), and commence digging among the stones, when he will come to a reddish-brown soil, highly impregnated with natron, which the natives collect for top-dressing on their fields below. There he will find abundance of Nile shells distributed throughout the soil from the margin of the cliff above the temple inland for upwards of a mile, and until the drifted sand of the desert makes it difficult or impossible to trace them further; indeed, the same appearances are observable along the right bank of the river throughout the distance just indicated. These fossil fluviatile shells belong to species nearly all of which have been proved to exist in the Nile at the present day, and comprise the following species, determined from specimens sent to the Geological Society of London, and examined by the late eminent conchologist, S. P. Woodward, F.G.S.:[2]— *Unio "lithophagus?" Bulimus pullus, Paludina bulimoides, Ætheria semilunata, Cyrena fluminalis,* and variety *trigona, Iridina nilotica.*

About thirty-six miles below the first cataract, on the right bank, at divers levels, from twenty to thirty feet and upwards above the level of the river at its highest, water-lines of the present day may be seen, beds of the common Nile oyster, *Ætheria semilunata,* not only scattered in enor-

[1] Built about 1355 B.C.

[2] See Note to author's paper on the Geology of the Nile Valley, *Jour. Geol. Soc. London,* vol. xix. p. 19.

mous quantities throughout the soil, but adhering to their old rocky bottoms.

From these data we may fairly surmise that Egypt and Nubia participated in like movements with other portions of the continent to the east and west; but whether or not, in common with them, they were entirely submerged under the sea at the same epoch, is not so clear, as no marine shells have yet turned up in either Egypt or Nubia. No doubt, however, when the depression of the Sahara and Red Sea regions took place, Nubia was not entirely submerged, although possibly Egypt was under water up to near the first cataract; moreover, it is to be inferred from this that the epoch when the Nile flowed over the elevated plateaus of Nubia was anterior to the downward movement of the country; and consequently that the relative levels of both countries were then much higher than at present, which would lead to the supposition that primeval Nile was a far more rapid river than it is at present, with a broader channel, especially at the cataracts, where it is now much contracted. This surmise, moreover, is strengthened by the fact that I met with river-shells in abundance throughout the Great Valley eastward of Asowan, which commences at Philœ, at the top of the first cataract, and, after coursing round for a distance of 7½ miles, debouches on the river to the north of the town. This valley, according to a late survey, attains a height of 100 feet[1] above the highest modern water-mark of the river at Philœ. No doubt further researches on this interesting and important subject, more especially excavations in Lower Egypt, will bring to light valuable and doubtless convincing proofs with reference to these undoubted oscilla-

[1] Hawkshaw on the Geology of the First Cataract. *Jour. Geol. Society*, vol. xxiii. p. 119.

tions of level, which ended in the present configuration of the northern portion of Africa.[1] The many intelligent observers who annually resort to the country on the score of health or pleasure, could not employ their leisure hours in a better way than in attempting to determine such phenomena as I have just pointed out; indeed, it appears surprising that so little has yet been done by the numerous accomplished explorers who have traversed the most accessible portions of the Nile Valley.

XVII.—NUMMULITIC LIMESTONE OF LOWER EGYPT.

THE nummulitic limestone of Lower Egypt abuts in various localities about Cairo, where the student will meet with many interesting objects. It is seen to advantage in the neighbourhood of the old city, and the perpendicular sides of the eminence on which the famous citadel stands; here the perfect horizontal bedding of the strata, showing soft and semi-crystalline layers, are charged with a great variety of fossil remains, which may be obtained without much trouble. Entire shells or casts of *oysters*, *pholas*, *echinæ*, *cidaris*, *clypeaster*,[2] and various sorts of nummulites, abound. The lithological character of the rock varies considerably, and there is great variety in the fossil remains. As a matter of

[1] The observations of Drs. Russegger and Murie have already confirmed the existence of fresh-water oyster-beds along the banks of the Blue and White rivers; but I don't know how far one is justified in claiming priority in such statements, or in the discovery of shells at high levels, seeing that Herodotus, unless he is referring to nummulites and shells in the rocks, states (*Euterpe*, ii. p. 10 *et seq.*) that Egypt was once a bay, and "that shells are found on the mountains."

[2] Besides *C. œgyptica*, Dr. T. Wright, F.G.S., identified in my collection several echinæ as being miocene, and of the same species found in the miocene beds of Malta. Thus it would appear, besides the nummulitic beds (supposed to be eocene), that miocene formations also exist about Cairo and the Pyramids.

course, the nummulites predominate, and often to an extent as to present cliffs almost entirely composed of them and other *Foraminifcræ*.

Petrified Forest.—We spent a day among the Mogattam Hills, examining the so-called petrified forest, which after all presents only the remains of what had, at one time, been a deposit of some thickness, but now, owing to denuding agencies, is restricted to a surface accumulation of rounded flints and angular fragments of rock, silicified fragments of trees, mostly endogenous, silicified sand and gravel, which repose on a reddish limestone, containing abundance of casts of shells, underlaid by a paler limestone with the same fossils as seen on the rock on which the citadel is placed. Fossil wood was also observed about the Pyramids. This silicified wood deposit appears to belong to a more recent epoch than the nummulitic rocks, and may be referable to a period immediately preceding the submergence of the Sahara and general depression of North Africa just noticed; or, in other words, contemporaneous with the age when the river flowed over the plateaus of Nubia. No traces of ancient levels or terraces were observed, but about Beni Hassan we could define terraced cliffs on the sides of the long straight glens, also ravines and larger valleys, which may in part have been formed by the denuding influence of the sea, during the oscillations of level, and since further opened out by atmospheric agencies. No doubt more extended observations would elicit important data in connexion with this interesting subject. Who can tell how far the Egyptian priests erred when they informed Herodotus that at the time when Menes, the first mortal, reigned over Egypt, "all the country except the district of Thebes was a morass, and that no part of the land that now exists below Lake Myris was then above

water"?[1] or that the ancient traditions of India, referring to the existence of a "water elephant" and "gigantic tortoise," may relate to the extinct fossil *Colossochelys atlas* and *Hippopotamus palæindicus*, as suggested by the profound palæontologist, the late Dr. Falconer, who discovered their fossil remains in the Miocene deposits of the Sewalik Hills.[2]

XVIII.—CHANGES IN THE CHANNEL OF THE NILE DURING THE HISTORICAL PERIOD.

THE data collected by Mr. Rhind with reference to the changes in the direction and level of the Nile within the periods recorded on the monuments on its banks, were made at almost every available point between the Delta and second cataract. The voluminous notes, and the accuracy wherewith the soundings and levels were taken, together with his intimate acquaintance with Egyptian antiquities, render his observations of great importance. With reference to the local changes in the course of the river within the historical period, evidences of these changes were very numerous, and their causes were clearly defined. On the left bank, near the celebrated rock-cut temple of Abo Simbul, there is a smaller one, the floor of which is now annually covered by the Nile during the inundation; and a short way further down, there is a niche in the rock containing an idol in a sitting posture, where the water-marks of the annual floods are observed about half-way between the feet and knees. This temple and stele are said to have been constructed sometime between 1322 and 1388 B.C. It is evident here,

[1] Herodotus, book ii. ch. 4, 11, and 12.

[2] See *Jour. Geol. Soc. London*, vol. xxi. p. 372: On the asserted Occurrence of Human Bones in the ancient Fluviatile Deposits of the Nile and Ganges, by Hugh Falconer, M.D., F.R.S.

that the force of the current is now impinging on the left bank, so that the soundings are deepest there, whilst the shallows and arenaceous deposits of the opposite shore testify to rapid accumulations in that direction. Again, the temple of Ombos, founded B.C. 200, is built on river alluvium, on which the river is now impinging, and has already undermined a portion of the foundation, whilst directly opposite the same appearances are taking place as observed in the last case. At Maneche, below Ombos, there are remarkable accumulations of river alluvium, forming banks from eighty to ninety feet in height, presenting a perfect stratification. These enormous banks of river alluvium are interesting with reference to what has been just stated in connexion with the oscillations of level, and may represent the ancient Delta when Egypt was covered by the ocean.

At the quarries of Silsilis there are very clear proofs of the change in the direction of the river's current since the monuments on its banks were built. Here, on the left bank, there is a grotto bearing the oval of Amenophis III., B.C. 1430, where the highest water-mark of the present day is about half-way up its inner wall, and a stele a short way northwards has the lower lines of its inscription almost completely worn away from the same cause. Like evidences are apparent in the neighbouring grotto of Tuthmosis III., the predecessor of the last-named Pharaoh. The soundings, moreover, show the river deepest on that side, whilst deposits of sand and mud are going on in the centre and towards the right bank. Again, the plain of Thebes is now annually covered by the Nile, so as to insulate the two Colossi. This has taken place since the Roman occupation, and is owing to the change in the course of the river above Luxor, its back-channel having become silted up, causing the river to push

more westward. The monuments of Philœ, at the top of the first cataract, show that, at least within the last 2200 years, there has been little or no change in the river's level, inasmuch as there are doorways and entrances in the western wall, also holes in the rock, to which boats were attached, and at different points; all suited to the present rise and fall of the river. These data may be considered conclusive, as far as any appreciable change in the level of the Nile since the periods represented by the monuments of Philœ, whilst the preceding exemplify only local alterations in the course of the main current, caused by silting up of its bottom in places. In fact, the Nile is no exception to other rivers in these respects, and is constantly changing its channel in places in accordance with obstacles, and is clearing away and making new courses for itself in situations it may have invaded and abandoned several times in its long history. Thus, as far as the historical period extends, from 3000 to 4000 years, there has not been any material rise or fall in the bed of the Nile.

XIX.—ENCROACHMENT OF THE DESERT.

THE drifting of the desert sands of Nubia, more especially along the river's banks, interferes greatly with the cultivation of the alluvial tracts, and markedly because that the population of late years has been gradually decreasing, in consequence of the emigration of the natives to Lower Egypt.[1] It may be surmised, therefore, that many districts,

[1] Emigration was at its height during our sojourn. The ruler, Said Pasha, then reigned in Egypt, and his anxiety to assist M. Lesseps and the Suez Canal rather overstepped what moderns would call the liberty of the subject. I have often witnessed lighters crammed to suffocation with unwilling Nubians, who had been seized and hustled on board for service in the construction of the Canal. The Turk was doing what the

at no very distant period, exposed to the Samiel and other prevailing winds, will sooner or later be completely overwhelmed by desert. Already many arable plains are covered over; indeed, the gradual desertion of entire villages, and the partial evacuation of others, are just in proportion to the steady encroachment of the desert. The struggle between man and nature is here remarkable, for, should the present order of things continue, it must finally eventuate in a complete victory to the latter whenever the odds are favourable. It is curious to observe how constantly the drifting is going on, even when the wind is not strong enough to raise the finer particles into the air. I was struck by this during a light breeze, when traversing what had at one time been a vast cultivated district near Ibrim, some distance below the second cataract. Here a vast plain, at no very distant date teeming with grain, is now nearly covered over by sand; the villages all but deserted, whilst the never-failing date and doom palms around them are overwhelmed in sand-drift for upwards of fifteen feet from their roots, just as may be observed in winter during cold weather, when the light snow on the surface is being carried onwards. In the former case there was a constant onward flow of the finer particles, which never ceased unless some obstruction came in the way. Every small twig produced a long tail behind, and most probably, in this same manner, did a bush of tamarisk on the plain give rise to the following curiously constructed mounds in the neighbourhood, many of which attain a height of ninety feet above the plain:—Along the left bank, for some distance below the second cataract, extend a series of

heathen Pharaoh, who built the Great Pyramid, is said to have done, only that the one was about the first despot in the country, and the other, let us hope, about the last, of the many who have flourished in this land of plenty.

sand-hills of a conical shape, and more or less covered with tamarisk bushes, which are seen growing on their tops and steep sides. A perpendicular section of any of these dunes resembles that of a densely packed hay-rick, from the quantity of decayed twigs of tamarisk interspersed among the sand.

The manner this takes place is no doubt owing to the constant drifting of the sands, by which the lower branches of the tamarisks get overwhelmed and die, whilst the seeds, and those from the upper boughs, take root, and thus a process of decay and reproduction is constantly going on; indeed, it is apparent that the height and elevations of the dunes depend on the numbers of bushes growing on them, whilst their trend is in the direction of the prevailing winds; moreover, were it not for the acacia and other bushy trees and shrubs surrounding many of the arable tracts, nothing other than high walls would prevent the intrusion of the desert. When engaged in surveying these mounds, our attentions were directed by a traveller, on his way up the Nile, to a published description of a strange grotto some distance inland. According to the account, it was a wonderful subterranean vault in the midst of the Libyan desert, never visited by any antiquarian before the writer, who stated that he found it to be a most remarkable cavern of large dimensions, and extending into the bowels of the mountain. A very garbled account of the author's ride on a camel through the desert, portraying the incidents of a night-journey across the sands, and the strange wonders he encountered, disposed my companion to believe that the whole was a gross exaggeration, such as certain travellers indulge in who wish to write a good story for a popular journal, in which the one in question was inserted. With the document in hand, I mounted a camel, and made the necessary arrangements for the day's work, which, according

to the description, would occupy several hours of desert travelling. The camel-driver, a native of the district, was perfectly ignorant of the existence of any grotto of the dimensions stated, but expressed a belief that it was one or other of the numerous sepulchres of the ancient race, so plentifully distributed throughout the ravines in the neighbourhood; and his impression proved true. After a rather long ride over a desert tract, remarkable for its wearisome sameness, we approached a small ravine with rugged sides, where the open mouths of several caves arrested attention, and, on dismounting, it was found that the largest of some three or more rock-cut sepulchres was the one we were seeking. In fact, it was nothing different from others of a similar description to be met with in hundreds along the banks of the river northwards, and consisted of a small square-shaped doorway opening into a chamber some fourteen by sixteen feet in length, and scarcely high enough to allow a moderate-sized man to stand erect. Two or more smaller rooms communicated with the above, and, on the floor of the first, was a square-shaped vault, nine to ten feet in depth, where the body had been deposited. The only interesting antiquarian point connected with it was the scribbles of the early Christian monks of the second century, in the form of litanies, written on the walls with red chalk, and in the Coptic dialect. Withal, the hermit, desirous of perfect seclusion, could not have chosen a more fitting abode; here in the desert, miles away from the habitations of his fellow-creatures, in the grave of the idol-worshipper, did, mayhap, some recluse of old pass his days with no companion save the bat or owl. One might picture the weathered seer, with matted hair, severe and serious aspect, sitting absorbed in thought in the dark corner of the sepulchre, now poring over the Sacred

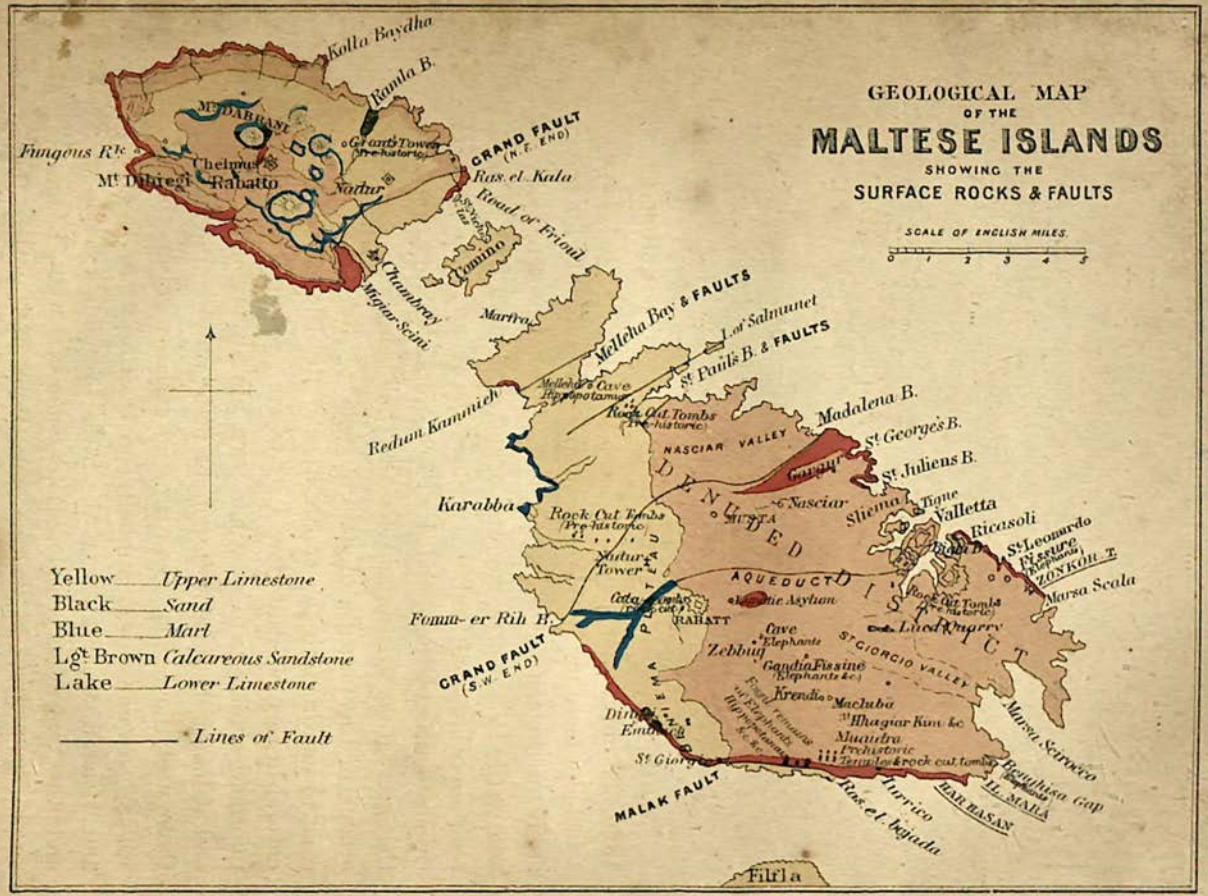
Volume, or mumbling his invocations, whilst, on the walls around him, are delineated the strange and uncouth figures of the past race, still bright and clear as on the day they were completed by the artist. There stands the hawk-headed god, with the ibis-headed Thoth, and a host of other allegories, which, for want of better substitutes, he has attacked with his hammer, and having chopped and battered the head until its brute form has been defaced (contenting himself, in the case of the ibis, by destroying its curved long bill). This done, he sets about, with his unapt hand, to paint "a glory" around the head of the deity, in order that it may now do duty for one of the canonized apostles of Christianity![1] I do not think I saw so many bats in any of the numerous subterranean vaults we visited. So plentiful were they in the above, that during my descent into the crypt I was covered by them, whilst hundreds fluttered about like bees around a hive. The long-eared bat (*Plecotus christii*) seemed the only tenant of the tomb on that occasion. Bats are very numerous in Egypt. The three-toothed (*Asellia tridens*), Egyptian (*Rhinopoma microphylla*), and naked-bellied bats (*Taphozous nudiventer*), were identified in various places; and there are doubtless several other species. The large-horned owl (*Bubo ascalaphus*) of the country preys on them, and hunts among the ruins at night. I was astonished at the quantities of

[1] Few of the large rock-cut tombs along the Nile banks do not present some traces of the early Christians, and this strange mode of utilizing the images of the idol-worshippers is not confined to the above, but was seen in other tombs visited by me. Nevertheless the antiquarian cannot afford to express regrets as regards the destruction of the monuments by ignorant persons, seeing that more than one Egyptologist has removed portions of valuable records from the walls of several tombs and temples, and a famous German savant has entagliated his name on the chest of what is acknowledged to be one of the grandest colossal human forms. I refer to the famous representations of Rameses III. at the entrance to the rock-cut temple of Abou Simbul.

disgorged pellets of this bird on the floor of the rock-chambers, behind the modern town of Sioot, famous for the numbers of mummied wolves, before mentioned. The pellets were composed entirely of the bones and hair of the jerboa (*Dipus ægyptius*). I think there can be now no doubt in regard to the specific identity of the horned owl of Egypt and the large rock owl of India (*Urrua bengalensis*).[1] I noticed the well-known barn owl (*Strix flammea*) clearly figured on the tombs of Beni Hassan, and procured a specimen in the palm-groves; but the most common of all is the bird of Minerva (*Athene meridionalis*). This pretty little owlet is diurnal in habits, and may be seen in almost every tamarisk and palm grove, or perched at the entrances of rat-holes. Mummies of all the above have been found at Thebes; but it would seem there is no proof that any of the owls were sacred, or that the last-named was an emblem of the Egyptian Minerva.

One of the strangest features in connection with the practice of embalming was the seeming indifference as to whether or not the animal was sacred, or connected in any way with their religion and language; but this point requires further research. By some Egyptologists it has been surmised that whatever were represented on the hieroglyphic writings were worthy of the same consideration as the sacred animals, and perhaps even those shown on the pictures were likewise eligible for embalmment; and as the process was entirely in the hands of the priesthood, there is a probability that much was left to the whim or fancy of the sacerdotal community to select whatever best suited their views.

[1] Jerdon says this species is "exceedingly similar" to the above.—*Birds of India*, vol. iv. p. 129.


GEOLOGICAL MAP
OF THE
MALTESE ISLANDS
SHOWING THE
SURFACE ROCKS & FAULTS
SCALE OF ENGLISH MILES.
0 1 2 3 4 5
Kalla Baydha
Ramla B.
Mt DABRANT
Fungous Rk
Chelmus
Mt Dbieġi
Rabatto
Nadur
Gigantic Tower Pre-historic
GRAND FAULT (N.E. END)
Ras el Kala
Road of Friuol
St Dimitro Tal Cemino
Cemino
Migiar Scini
Martra
Melleha Bay & FAULTS
Lor Salmunet
St Paul's B. & FAULTS
Redum Kammieh
Melleha's Cave Hippotamus
Rock Cut Tombs Pre-historic
Madalena B.
St Georges B.
NASCIAR VALLEY
St Juliens B.
Karabba
Rock Cut Tombs Pre-historic
Nasciar
Sliema
Valletta
Ricasoli
St Leonardo
Fissure Elephants
ZONKOR T.
Nadur Tower
AQUEDUCT
Marsa Scala
Fomm-er Rih B.
RABATT
Cave Elephants
Rock Cut Tombs Pre-historic
Lead Quarry
Zebbug
Gandia Fissure Elephants &c
ST GIORGIO VALLEY
GRAND FAULT (S.W. END)
Krendia
Macluba
Mhagiar Kum &c
Muaidra Prehistoric Temples & rock cut tombs
Marsa Scirocco
Benghisa Gap
Ras el Bigiada
Turrico
EL MARA
BAR HASAN
MALAK FAULT
Filfla
Yellow ____ Upper Limestone
Black ____ Sand
Blue ____ Marl
Lgt Brown Calcareous Sandstone
Lake ____ Lower Limestone
Lines of Fault

MALTA.

PART I.

INTRODUCTORY.

WHEN I first set foot on the Maltese islands, June 22, 1860, an impression came over me that I could not have selected a more uninviting and uninteresting locality for the study of the natural sciences—bare, weather-beaten, rocky, and sterile to a degree, no woods, and scarcely a tree to be seen anywhere—all surface verdure burnt up by a semi-tropical sun and the dreaded sirocco, were the appearances that greeted my arrival, and, for the time being, damped my ardour in the pursuits of natural objects. Resolved, however, to inquire into the capabilities of the islands from a natural-history point of view, I set to work to obtain all the information relative to what had been already accomplished, and at length bethought myself of first studying the ornithology of the region, more especially the migratory birds which pass and repass annually on their ways to Europe and Africa. Accordingly, as the heats of summer declined, and other and more genial seasons came and went, I found ample occupation in making collections and noting the names and numerical prevalence of the various birds of

passage which make the islands their "half-way house." It became soon apparent, however, that the same laws as regards times of arrival, and numbers of each species, were found to be here, as elsewhere, remarkably regular, so that I was enabled, after several years' experience, to estimate the relative proportions of each with considerable certainty. I set also to work to study the rock formations and collect whatever data I could in connection with the geological history of the little island group, standing out in the centre of the great inland sea, and within sight of Sicily, to which, I thought, it would be important to discover what proofs existed of their having been at one time joined together.

There are few islands better circumstanced for geological researches than Malta, Gozo, and the detached insular rocks on their coasts; the surfaces being bare for the most part, and the sea-shores rocky, with excellent cliff exposures; moreover, there is a great abundance of fossils, which are easily extracted, owing to the general soft mineral structures surrounding them. During the six years I sojourned on the area, I managed to bring together a vast variety of animal remains of the original sea-bottoms represented by these rocks, embracing many new and hitherto undescribed species, which have been recorded in the Proceedings of various scientific societies and Journals, to which reference will be made in the following pages. When prosecuting geological researches, my usual custom was to drive to the particular locality in that essentially Maltese mode of conveyance named a "go-cart,"[1] which I recommend to the

[1] The native cart has the axle placed far back. This model with springs constitutes the "go-cart," which again recently has been turned into a sort of inside car. A primitive two-wheeled vehicle, once the state carriage of the Knights of St. John (now rapidly disappearing), looks extremely like the body of a cab resting on leather springs between the wheels and the animal. This arrangement, when the animal

student as being well adapted for the rough lanes and country roads over which the geologist must wander.

I was not long in Malta before my attention was directed to a remarkable discovery of fossil bones and teeth of hippopotamuses which had been found in a limestone cavern on the southern coast. This aroused my exertions to seek for more fossil-bearing caverns; nor were my efforts long unrewarded; so that, by the end of March 1866, when I left the islands, there had passed through my hands and been dug up under my immediate superintendence (from fissures, caverns, and surface-soil), teeth and bones of several hundreds of elephants and hippopotamuses, besides innumerable quantities of the remains of an extinct dormouse as large as a guinea-pig, together with the exuviæ of enormous tortoises, etc., with abundant vestiges of aquatic birds, some of which must have greatly exceeded the dimensions of the swan, etc.

At length, when the term of my departure from the islands drew near, I went to work, and, to use a mercantile expression, "took stock," and arranged the data I had obtained with reference to the fauna, descriptive geology, and palæontology of the islands, when it became clear that I was in a position to add materially to the previous evidences, which had furnished strange but cogent proofs of the ancient condition of Southern Europe and North Africa. I shall presently point out many of the various animals which frequented the sea-bottoms of which the Maltese rocks formed part, and the facts demonstrative of the extent, physical aspects, fauna and flora, of this ancient Miocene sea-bed, when upraised

moves into a trot, necessitates a constant up-and-down movement, which, in the case of a young lady, comes to be "peep-bo," perhaps, on the whole, very agreeable, provided the object of her solicitations happens to be passing by, but certainly the serious priest or severe-looking signora cut a rather undignified and somewhat ludicrous appearance on such occasions.

above the Mediterranean waters, together with the proofs of the first human occupation, as shown by their far-famed megalithic ruins and rock-cut tombs. I would fain, however, in the first place, and before introducing the reader to the Malta of our times, attempt to prepare him for what I have to say of ancient Malta; in those days, when such animals as I have just mentioned herded in hundreds and thousands on a country, of which it is the remnant; for, whether seen from a distance, or examined in detail, Malta is about the last island we could imagine had been tenanted by such animals as the elephant and river-horse; still that grey and barren rock must have been at one time clothed with verdure; inasmuch as what is now a bare sloping sand or limestone, on which grow the euphorbias and wild artichokes, was at one time covered with a productive soil and luxuriant vegetation. Tall reeds must have fringed the banks of its lakes, rivers, and lagoons, and tree and shrub must have flourished in profusion, for the now waterless wastes and dry gorges, seen here and there over the little islands, once resounded with the snorting of the hippopotamus and the shrill trumpets of strange elephants, and were part and parcel of a land the major portion of which is now under the blue waters of the Mediterranean. What a vast change has taken place in the physical geography of Southern Europe and Malta since those times! Thus read by the vivid flickerings of light disclosed by their bone caves, we are at once enabled to establish the presence of a large land area where there are now only a few paltry barren rocks; moreover (as will be shown in the sequel), whilst Sicily and Malta were in all probability connected, there is still further proofs that the former was joined to Africa, as shown by soundings and the presence of the remains of the African elephant and hyæna, etc., having been repeatedly met with in a fossil state in its soils and cavern deposits.

I think, therefore, it will be apparent to the reader, that my first estimate of the capability of the Maltese islands, as regards the study of the natural sciences, and as seen through the close and sultry atmosphere of midsummer, was very far from the truth; indeed, as regards intellectual improvement and pleasurable occupations, I can confidently state that, during my six years' residence in

"Calypso's isles,
The sister-tenants of the middle deep,"[1]

I never lacked employment in my leisure hours; and this, I presume, is saying a good deal for Malta, which enjoys no enviable reputation in that respect, at least among the military residents, who form the chief portion of the British population.

I.—ASPECT OF THE MALTESE ISLANDS IN MIDSUMMER.

THE physical aspects of the Maltese islands in midsummer are by no means inviting. Viewed from a commanding position, they present an extremely sterile and desolate appearance, which is heightened by the interminable stone walls, rocky ravines, bare plateaus and plains, without marsh or stream; for, excepting a few fig, vine, cactus, carob, orange, pomegranate, and Persian lilac trees in gardens,

[1] There is a very extensive rock-fissure, forming a cavern of large size, in north-western Gozo, overlooking a beetling cliff, where tradition has (but I suspect the imagination of the guides when interrogated by tourists) fixed on this very isolated locality as Calypso's Cave. It is covered with the usual stalactitic incrustations observed in limestone caverns, but I could find no trace whatever of any human or other occupation along its dark and uneven passages. I shall again refer to the cavern under one of the churches in Città Vecchia (the ancient capital), where a marble statue of the Apostle Paul is meant to show that he took up his residence there during his reputed visit to the island.

or about the towns and villages, not a blade of grass or plant of any sort is there to gladden the eye or relieve the glare of a semi-tropical sun.[1] The great heat of the day rendering outdoor pursuits unpleasant from the want of tree and shade, I was compelled at this season to restrict my excursions to the early morning and afternoon.

Reptiles.—The quantities of loose stones and bare rocks offer tempting retreats for scorpions, snakes, and lizards. The latter are very plentiful, more especially the common lizard (*Podarcis muralis*), which may be seen basking on almost every stone by the road-side. Scarcely two are marked alike; the brightness and variety of their hues are most beautiful and attractive, and, like the chameleon, they change colour with the coruscations of sunshine, but of course not to the same extent. During an excursion to the islet of Filfla, on the southern coast of Malta, in the month of June, I was surprised to find that all the lizards on the rock were of a beautiful bronze black, and so much tamer than their agile brethren on the mainland. Many individuals were so tame that they scrambled about our feet, and fed on the refuse of our luncheon. I subsequently sent specimens of this variety, or rather race, to England, and had them confirmed as being identical with the above species. How are we to account for all the lizards being black on this little rock, not more than 600 yards in circumference, and only three miles distant from Malta, seeing that, during six years' sojourn in Malta and Gozo, I never observed one black individual? unless we suppose that two or more dark-coloured varieties had been either introduced, or were left on the

[1] The cultivated districts of the islands amount to 54,716 acres; the uncultivated, or rather rocky and irreclaimable districts, compose 46,810 acres.—*Smyth's Mediterranean.*

islet when the subsidence took place which severed it from the mainland; the latter I will show to be clearly defined by the opposite fault or downthrow, of which Filfla is a fragment. We found the stormy petrel, Manx, and the cinereous shearwaters breeding in the crevices of the rock, the two latter so tame that many were actually captured in their nests. The eggs are pure white.

None of the Maltese snakes are poisonous,—a rather remarkable circumstance, for, according to bibliologists, it was here that the apostle Paul was bitten by the "venomous beast," which "he shook off and felt no harm."[1] The spotted snake (*Callopeltis leopardinus*) and the *Coluber viridiflavus* are the only two vipers; both are plentiful, but exceedingly timid. This is not, however, the case in Sicily. I recollect mounting a hill behind Messina one afternoon, and so abundant and indifferent was the former species, that I had to look out in order not to tread on them; indeed, it was only when touched with our alpenstocks that they would move, whilst other individuals glided off for a short distance, and, as we approached, they reared up as if to set us at defiance. Several other lacertine species, besides that described, are met with in Malta, including the *Ascalabotes mauritanicus*, *Hemidactylus trichedrus*, and *Gongylus ocellatus*. The sea-tortoise (*Thalassochelys caretta*) is frequently seen in the market, and in the immediate vicinity of the islands; and, lastly, the frog (*Discoglossus pictus*).

The Maltese and Italians indulge in a dish by no means inviting to Englishmen; but I have been assured by the lower classes, to whom it is most welcome, that that most

[1] Maltese historians mention certain native earths and clays esteemed as remedies. St. Paul's earth was supposed to be an antidote for snake-bites, and the terra sigillata Melituæ was considered cordial and sudorific. —See *Boisglin's Malta*.

loathsome-looking mollusc, the octopod, better known as the poulpe,[1] when stewed with tomatoes and other vegetables, is extremely savoury; and the same of the calamary. I have seen a fisherman spend an afternoon hunting after a single poulpe, which they generally catch in baited basket-nets. The species usually observed were the *Octopus quoyanus* and the *Eledone, octopodia* of Aristotle, mentioned also by Homer. Both are plentiful along the rocky shores of the islands, but are not easily captured.

Mammals.—The indigenous quadrupeds are not numerous, and comprehend only the weasel, hedgehog, rabbit, horse-shoe, and long-eared bats. The first affects the dikes and stony places, but is not common; the hedgehog and rabbit cultivated tracts. The latter is seemingly a variety with a sparser fur, and lighter brown shades on the upper parts than the rabbit of Northern Europe.[2] It burrows in the marl-heaps in sequestered parts along the coast-line, but is nowhere common.

The domesticated animals of Malta, more especially

[1] In France they are both stewed and fried, and, among our own fishermen on board the trawlers, the young cuttles are frequently eaten. In Mr. Campbell of Islay's delightful book, *Life in Normandy*, an epicure says, "Let us take a small glass of this Spanish wine, and then I must beg you to try the cuttle-fish. I have taken them under my own special care, and I am anxious they should please you, for I can answer that the eyes were properly extracted, and every fish has been well hammered." For those interested in the subject, I would refer them to this book. The poulpe holds on most tenaciously by means of its many suckers. I know of an instance where one gained admittance into a bathing-house on the shore of Malta, and nearly caused a child to be drowned by twisting the long arms around its legs.

[2] Although there is every facility for rabbits to increase, especially among the rocky parts along the southern coasts, they are not plentiful, perhaps for the reason that they have formidable enemies in man and the weasel.

cattle, sheep, and goats, deserve notice. The native cattle and sheep of the islands being few, and belonging to the poorer classes, what between constant interbreeding, and no selection whatever, there is a marked deterioration of race; thus the cattle are all fawn-coloured, tall, with gaunt, lanky bodies, and large bony limbs, and precisely the same appearances characterize the sheep. Only sufficient bulls and rams are preserved to propagate the race, the cows being kept for the combined purposes of labour and any little milk their small udders may supply.[1] The sheep and goats are the chief milk-producers, the latter participating to a great extent in the physical characters of the former. Nowhere else, however, are goats to be seen with more enormously developed udders, thus affording a good example of constant use in enlarging organs. I have seen their udders so exaggerated as to trail on the ground during progression. A good milk-goat will furnish one-third of a gallon of milk at one milking. During summer it occasionally happens that a number of persons are suddenly seized with nausea, vomiting, and diarrhœa immediately after meals at which goat's milk is used, and it has been supposed that the symptoms were owing to the milk having been poisoned by the animals feeding on the spurge.[2] No doubt, during the hot months, when the plants are all withered and pasturage scanty, goats do frequently eat the stalks of the spurges, which are very plentiful, chiefly *E. pinea*, and the goatherds and natives generally believe that the milk becomes poisonous from this

[1] The frontal bones are largely developed, equalling the same in the skull of the extinct *Bos longifrons*, from which race they may have sprung originally.

[2] The same has been asserted in regard to the flesh of the Ruffed and Canadian grouse, which had fed on the leaves and berries of the American mountain laurel.

cause, and are at pains to prevent the goats from feeding on them. They assert, moreover, that the same consequences will follow from drinking the milk of goats which have eaten the berries of the Persian lilac, but, as in the former case, the animal itself does not suffer in health. I believe experiments instituted by order of the local government did not establish the truth of these assertions; still I was informed by natives in Gozo that a few drops of any of the common spurges put in milk is a common mode of purgation among the lower classes, and used in preference to other remedies.

The bare and rocky surfaces, more especially in the times of the Knights, permitted only mules and donkeys to be used as beasts of burden. Accordingly much pains were taken with the rearing of them; and whether introduced or not, the islands were long famous for their superior breed of mules and donkeys. Very few of the latter now remain.

The mule used at present is of large size, and forms the chief draught animal in the rural districts. It may be remarked that the so-called Maltese dog of the London fanciers is not the famous favourite of the Grand Masters, and just about as like the latter as a poodle is to a short-haired English terrier.

Resident and Migratory Birds.—The resident birds of the islands are remarkably few, and comprise not more than ten to twelve species, whilst, according to the latest researches of Mr. C. A. Wright,[1] the annual migratory visitors and accidental arrivals amount to no less than 240 species. The regular winter birds are in excess of the regular summer birds, owing to the circumstance that the country is most inviting at that time.

[1] *Ibis*, January 1864, p. 1.

Spanish Sparrow.—Among the stationary avi fauna, the Spanish sparrow (*Passer salicicola*) is the most abundant. As regards North Africa and Egypt, this species is strictly agrarian, frequenting cultivated districts and reedy swamps, where it is very gregarious, whilst in Malta, where there is scarcely any arboreal vegetation, and an uninviting country, it betakes to the towns and villages, occupying the position of the domestic sparrow, which is not a native of the islands. Of numerous specimens I have examined in Egypt, I could not discover any deviation whatever from the typical character of the *P. salicicola*, whereas in Malta it is not uncommon to meet with males having the dark streaks on the flanks faintly marked, and sometimes wanting, as in its congener of Italy. Perhaps the abnormal change in the habits of the Malta sparrow may have produced these variations in plumage;[1] it is also less gregarious, excepting in May, after the breeding season, when flocks may be seen in gardens and pomegranate groves. It will, I think, be observed, that the different species of sparrows which resort to the haunts of man, and there breed, simulate, as it were, the habits of poultry, by showing a strong disposition to breed at all seasons. In India, I could scarcely make out when the domestic sparrow was not so employed, and frequently it is observed breeding in midwinter in England. It is perhaps, therefore, this prolificness and changed conditions of life that have modified the markings on the flanks of many individuals of the Spanish sparrow of Malta, as both the domestic and last-named species herd together in great numbers in Egypt; and yet, although I took some trouble

[1] I am more disposed to adopt this view than the opinion lately expressed to me by Mr. Gould, that the Maltese sparrow may be a cross between the Spanish and Italian sparrow, which is common in Sicily.

to ascertain if a cross takes place, in no instance was there any deviation observed from *P. salicicola et domestica* of authors.

Bats.—The little horseshoe bat (*Rhinolophus hipposideros*) may be observed at any season, but is of course most plentiful in summer; however, at twilight during the balmy southern winds of midwinter it occasionally ventures forth. Its congener, the long-eared bat (*Plecotus communis*) is not nearly so common, but may be found in the caverns and catacombs of Citta Vecchia. Specimens compared with descriptions of *P. communis* of England were found almost identical, but it has closely allied congeners in Southern Europe and Northern Africa.

Short-toed Lark.—One of the chief denizens of the sunburnt and baked fields of the islands during the heats of summer is the short-toed lark. It comes in flocks about the end of March, and breeds in June. The sandy-coloured plumage consorts with surrounding objects, and with the exception of the blue rock thrush, it is the only summer songster. Its whinchat-like note as it ascends, and characteristic flight, composed of a series of upward jactitations, distinguish the species at a distance. Being the harbinger of the hot months, a true sign of the coming winter is when short-toed larks are seen collecting. They travel southwards by the end of September.

Black Swift and Swallows, their Migrations.—The black swift, accompanied by the chimney-swallow, house and sand martins, appears in Malta in the beginning of April. The first remains in the island throughout the summer, taking

its departure early in September, long before the weather can be said to influence its habits, unless that then there is a failure of the particular insect life on which it feeds—for the climate during the next four weeks, at least, is warmer than that of midsummer in England.[1] It may be, however, that, having reared its young, there is no further inducement to linger longer about the towns and rocky shores. This anxiety to depart as soon as the young birds are strong on wing, and before the cold nights, is also apparent in its congeners of North America. The purple swallow arrives in Canada towards the end of April, before the ice has completely broken up, and departs before the middle of August—the difference being, that in this case it was expediting its movements for the purpose of incubation, and, with that object in view, was prepared to face difficulties it cared not to encounter, after the duty was performed.

Jackdaw.—The jackdaw is a resident, and builds in the fortifications of Valetta.

Habits of the Maltese.—The Maltese in the inland towns and villages, more especially females, have a rather curious predilection for indoor life; so marked is this, that in walking along the narrow lanes at mid-day, it is like wandering through a city of the dead. Excepting a few shops, scarcely a door is open, and the dead silence is only broken by the hoarse bark of the lean pariah dog on the flat roof-tops, or the chirping of colonies of sparrows in the walls. I have often wondered if this habit of seclusion could be an ancient relic of their Mahometan conquerors; and it is also in keep-

[1] I found this species and the white-bellied swift very common around the glaciers of Grindelwald at the latter end of August, when the ground was covered with hoar frost every morning.

ing with them that the females in the more distant parts are seldom seen with their husbands, and when going to chapel, it is almost the invariable custom for the wife to walk silently behind her lord, as if she was but a menial.[1] Whilst on this subject, I cannot here refrain from acknowledging the great obligations I owe to the simple, kind-hearted rustics of Malta, whose fences I so often broke down, and over whose wheat-fields and orchards I have walked in a most unceremonious manner; how with pickaxe and shovel I displaced the scanty soil, or broke unsolicited into caverns on the farm. I can picture the brown-skinned and wiry son of toil, with his nightcap-like head-dress and tight-fitting under garments, bare arms and feet, standing by in wonder at what I was doing, whilst the black-eyed village urchins in boisterous mirth came crowding towards me, half-timid, half-confused, until assured that the "Inglese" meant no harm, and as they listened to their senior addressing me in his mongrel Arabic, they would catch up the oft-repeated word "antiqua," and from that day henceforth they dubbed me the "ancient," with a "*Sa ha*" (good morning) whenever I passed through their village.

I had often amusing dialogues with the countrymen concerning the object of my geological researches. Once, when employed with my late lamented friend Captain Strickland, R.N., in excavating the large cavern of Har Hasan, on the

[1] The Maltese historian Boisglen, who wrote at the beginning of the present century, asserts that the Maltese women have small hands and feet. I regret I cannot fully indorse this opinion, as far as the fair sex of the present day are concerned; no more than assent to his theory that the constant use of the *faldetta* causes them to squint. This head-dress, although not becoming in old people, has always appeared to me particularly pleasing on "the young and beautiful," of whom there are an average number. If (as I believe) chastity and virtue distinguish them, I am certain that sobriety and industry characterize the opposite sex.

south coast of Malta, we had dug a trench in the soil on its floor some six feet in depth, in quest of organic remains, when the natives in the vicinity, hearing of our presence, came in numbers daily to witness the proceedings, interrogating the workmen with reference to the object of our researches, of which they were about as ignorant as themselves. One afternoon three stalwart fellows paid us a visit, and whilst they sat on the heap of débris staring down into the dark ditch below, I dropt a Spanish dollar on a shovelful of earth, and next moment it lay with the soil on the heap, when, picking it up in an unceremonious manner, I put it in our luncheon-bag, and in a few minutes afterwards our friends disappeared, muttering to one another as they went. Great was our mirth next morning to find that our trench had been carried fully four feet below the level we had gained on the previous evening; not only that, but several other excellent sections of the floor had been made by them in expectation of finding money.

The central position of the insular group presents, on the whole, a fair stand-point in estimating the numbers and description of birds of passage, but the absence of wood, fresh-water lake or stream, and the generally bare and uninviting surface of the country, doubtless repel many bird-wanderers, more especially aquatic species. The only locality at all likely to attract water-birds has now been completely drained. It was a small lagoon at the top of the grand harbour, where the Maltese, always very fond of going "a-gunning," used to recreate themselves around its margin and wait the arrival of the common and jack snipes, which come in in wisps, and usually by moonlight, departing before daylight. Here a few sheldrake, shoveller, mallard, summer and common teal, pintail, widgeon, and castaneous ducks,

were killed every spring and autumn; now occasionally a few alight in the harbours and bays, but in no instance can the numbers be considered in any away as exponents of the extent of the migrations of the species they represent. As a matter of course, among the insectivorous and soft-billed birds, and the migratory raptorial species which feed on them, we are most likely to gain the most trustworthy information in relation to their numbers and times of passage to and from Europe and Africa.

Rapacious Birds.—Of the Raptores, which appear regularly in spring and autumn, the following species are the most common :—The kestrel, and lesser kestrel; also the orange-legged falcon may be seen in flocks, all hunting together. The last is partial to small birds; but I have also occasionally found birds in the maw of the kestrel. A few kestrels keep about the islands and breed, but the majority push on with the other visitors. Nowhere are the feathered tribes more persecuted than in Malta. I believe I shall be within the mark in stating, that about one-half of the migratory species are captured or shot, and of all days, on Sunday the greatest carnage is perpetrated, so that on the following day the poulterers' shelves are stocked with all manner of birds, great and small. Thus, by regular visits to the market, a good collection of the migratory birds might be made. Two of the favoured tit-bits of the Maltese epicure are the pretty little scops-eared owl and goat-sucker,[1] which arrive in vast numbers as early as the beginning of March. I tamed several scops-eared owls captured in birds' nets. It is a very docile and attractive cage-bird. That cosmopolite, the

[1] One specimen of the red-necked night-jar was captured in the islands some years since.—Wright, *op. cit.*, p. 18.

short-eared owl, comes and goes every spring and autumn in numbers, and feeds on tit-larks, as well as rodents and insects. The pale-chested harrier (*C. swainsonii*) is about the next common raptorial harrier species, and feeds sumptuously on the lizard and small birds. I have found portions of quail in the craw of this and the moor buzzard. It is a wonder that both do not remain in the islands throughout the summer months, considering the abundance of lizards there. I presume, however, the absence of trees on which to breed is the cause of their short stay in spring, and the cold sending the lizards into the dikes, drives them to North Africa in autumn. Mr. Wright procured many females of the blue hawk (*C. cyaneus*), but never saw a male, which is remarkable. It may be a question if the *C. swainsonii* and *C. cyaneus* are other than races of one species. The moor and honey buzzards (but neither, as far as they appear at Malta) represent extensive migrations as to numbers, and, to a still smaller extent, the osprey, sparrow-hawk, Montagu's harrier, peregrine falcon, hobby, merlin, barn-owl, are also influenced in their stay no doubt by the inimical physical conditions of the islands. Any other birds of prey must be considered merely as accidental visitors blown by gales from Sicily or Africa, or wanderers out of their course.

II.—ASPECT OF THE ISLANDS IN MIDWINTER.

As far as verdure is concerned, Malta may be said to be in its prime in February. It is then the daisy and dandelion deck the meads, grassy lanes, and waysides; wheat is ripening, and the luxuriant tops of the purple vetch[1]

[1] Malta is supposed to have derived its Roman name Melita from its superior honey, which is still famous, the bees obtaining it chiefly from the flowers of this vetch and the aromatic wild thyme.

(*Hedysarum coronarium*) adorn the terraced fields, and commingle their flowers with the red poppy, yellow marigold, daffodil, crimson pheasant's eye, and purple anemone, where the painted lady, cabbage, clouded saffron, and other butterflies are sporting. The evergreen of the stunted locust or carob tree (*Ceratonia siliqua*) consorts well with the scene, whilst the bare boughs of the fig stand out in inanimate ugliness against the stone fence around the terraced fields. Here and there a small flat-roofed barn occupies a corner of the little flat, for the Maltese huddle together in villages, and rarely is a solitary house to be found in the cultivated districts.

Winter birds.—To the ornithologist there is not much variety in the fields in midwinter. Among the crops of cacti (*C. opuntia*) a solitary song-thrush or blackbird is occasionally seen; from the dike-top the ringing note of the bunting (*E. milaria*), the chirpings of the reed sparrow from the house-top, robin and the chiff-chaff, utter their well-known call-notes. A few song larks, and a solitary pied or grey wagtail are occasionally observed; but of all the mid-winter tenants of the fields the tit-lark is the most plentiful. A stonechat, or the white-fronted redstart, hops along some stony lane, whilst small flocks of chaffinches are seen among the tree tops. About this season of the year, when the northern blasts blow strong, and the gregale lasts for three days at a time, then may appear such accidental visitors as the fire and golden-crested wrens, pelican, crossbill, fieldfare, missel thrush, rook, etc.; but many of the early winter birds push southward by the middle of January, as soon as the fields have been ploughed, and the crops are getting up. The cold sends the lizards into the dikes. Many of the little

valleys on the Benjemma heights, along the southern coasts and in Gozo, are extremely pleasant to wander over at this season. The calm, joyous, and exhilarating feeling, the bright, cool, sunny day, every one seems happy, from the farmers singing their Arab chants; in fact, the stillness is only broken by them and the warblings of the feathered tribes. Such weather makes one very contented, and to none more than the disciples of the hammer and chisel, tapping along the cliffs and weather-worn rock faces overlooking the valleys, where they may prosecute geology in a very pleasant way among the crumbling rocks and parting masses of limestone; here complete sections of the upper beds, and their fossils sticking out in bold relief on the weather-worn faces, may be explored for miles. It was an occupation of mine, whenever I could command leisure, to examine every section, and clamber among the rocky ledges in quest of fossils; and if there is one pleasant reminiscence more acceptable to my memory than another, it is those happy winter days, when I used to crawl along the beetling cliffs of Emthaleb and its neighbourhood fossil-hunting, with the blue thrush, sirin finch, linnet, and spectacled warbler singing sweetly among the olive-trees below me.

It is a strange contrast to walk through the orchards at this season, and observe the orange in full blossom, whilst the fig and mulberry are leafless: it looks as if nature had assembled her incompatibles. About the 15th of February wheat is in ear, and the progress in vegetation may be said to have reached its height. The very few soft-billed birds which winter in Malta, most, especially the chiff-chaff, do not seem to feel at all comfortable when the cold northern blasts are blowing, for then insects are scarce; still I have never seen it so cold that the cabbage butterflies were not

about, although now and then they appeared very feeble. This, and the circumstance that many dipterous insects live throughout the year, sufficiently attest the mildness of the climate. I suspect the common bunting has two broods, as it rears one in Malta in spring, and is off towards Europe by the beginning of June. I don't think there is any difference in size between this bird and specimens from Northern Europe, but many robins examined were smaller than the birds of England.[1] Enormous flights of locusts have passed over Malta at different times, and although the insect is to be met with usually in the gardens and villages in winter, I have noticed them more plentiful during some years than at others. During a south-west wind, on the 14th of March 1861, I observed an unusual flight of locusts in wing among the pomegranate groves in one district evidently migrating.[2] A large green mantis, two and a half inches in length, with spotless wings, is not uncommon in cultivated districts in autumn. Frogs spawn, and the resident birds commence to pair, in February. It is the border season between the winter and spring, when the migratory birds are thinking of moving northwards from Africa, and a few early scouts are to be found, such as the sand-martin, wheat-ear, and now and then an adventurous quail.

Of all the indigenous songsters none is more attractive than

[1] It is migratory at St. Petersburg.

[2] Besides the *Locusta migratoria*, I have captured individuals of the more elegantly-coloured *Acridium peregrinum* of North Africa, which may have migrated, but no doubt solitary individuals of these, and such-like insects, are frequently conveyed by ships to distant lands. In November last a live specimen of *L. migratoria*, captured in a house in Cork, was identified by me; at the same time printed notices of other individuals having been found in various parts of the south of Ireland, and in England, would indicate that a flight of locusts visited the British islands about the beginning of the month.

the pretty spectacled warbler. This delightful little creature has a sweet note, somewhat like the whinchat, and during the breeding season the male may be seen rising like a pipit in the air, and fluttering upwards, then it dives down suddenly. The species breeds among the euphorbia bushes and tall stems of the vetch.

But of all the Philomelians in this region next to the nightingale I prefer the blue thrush, *Petrocincla cyanea*. During the bright sunny days just referred to, it is delightful beyond measure to wander along the cliffs and listen to the mellow, melodious, and plaintive notes of this bird, as it flutters from rock to rock, now sallying forth from the beetling crag, fluttering its azure wings, it pours forth its love-song, then wheeling suddenly round, returns to its perch, where, in a crevice, sits its mate on the straw-built nest, which contains generally from four to five green-blue eggs, mottled and spotted with pale red and violet. The young are in great repute for cage-birds, and fetch high prices in the market. A piece of red cloth and cowrie shell suspended in the cage is supposed by the natives to repel the influence of the "evil eye," which they believe exerts baneful effects on man and beast. Perhaps the application of this belief to the blue thrush may have arisen from the following peculiarity in tamed individuals, as recorded by Mr. Wright in his excellent list of the birds of Malta :[1]—"The blue thrush becomes strongly attached to the locality in which it has been brought up, and seldom quits it. This affection is also shown in a state of captivity, and it rarely long survives removal to a new and strange place. Many instances of this kind have come under my notice. When the new market in Valetta was opened, many of the market people brought

[1] *Ibis*, January 1864, p. 24.

with them cages containing these birds from the old market, where they had been reared. One after another of the birds pined away and died, and in a few weeks not one survived the change of locality, and yet they were fed by the same hand, and with the same description of food."

In two instances known to me of purchases of blue thrushes by friends, both birds died suddenly a few days after their removal from their home, and without apparently any assignable cause, which, if general, would be against the importation of the bird, unless reared and accustomed to change of locality from youth. Its congener, the rock thrush (*P. saxatilis*) is met with both in spring and autumn, but does not make a lengthened stay on its way to either continent.

PART II.

I.—ASPECT OF THE ISLANDS IN SPRING.

A FEW extracts from my Journal will suffice to convey some idea of the spring and autumnal migratory birds, and also the climate of Malta at these seasons:—

April 15.—"Studying nature in such a climate as this during the winter and spring months is certainly most delightful. The temperature, continually mild, renders exertion pleasant, and one never feels overdone by walking fast, or the necessity of doing so in order to keep up the animal heat. I often stroll along the roads, or the terraced fields, over the interminable stone fences, up the valleys among ripening crops of barley and budding pomegranate groves; the rich red flowers of the latter are just appearing, and long since the fig has thrown out its broad leaves to shelter many a bird-wanderer from the south. The pods are green on the stems of the carob, and the bulrush is springing up rapidly in dank places near the sea-shore. It is harvest; the red vetch has been cut, dried, and stacked, and the yellow taint commences to tinge the corn fields. Summer is coming, but indeed, as regards verdure, it is truly winter, for in another six weeks a grey mantle will have covered the islands, and their surfaces will appear as bare and sunburnt as if no plant could flourish there. The green meads will become howling wastes, and the fierce

semi-tropical heat will imprison us from June to September. The gay songsters now crowding every available bush and tree and field, will have flown to more northern climes."

Migratory Birds.—The nightingale, oriole, white-throat, etc., now gladdening the Maltese landscape, shall in a few weeks be warbling and sporting in the olive and orange groves of Italy and other lands. By this time nearly all the birds of passage will have arrived, and the majority passed northwards. Redbreast, being the first to make its appearance in the islands from Europe, is up and off to northern climes by the end of March. The titlark also obeys a similar rule. Now the gay and welcome forms of the golden oriole, bee-eater,[1] cuckoo, chimney-swallow, martin, bank-swallows, black swift, spotted, pied, and collared fly-catchers, hoopoe, turtle-dove, pied, yellow and grey wagtails, roller, nuthatch, shrike, wryneck, nightjar, tawny and red-throated and tree pipits, stonechat, garden warbler, subalpine, yellow, wood, great sedge, sedge, Bonelli's and Vieillot's warblers are plentifully distributed over the country. The last-named species is not often observed as compared with nearly all the others, which may be said to migrate in large numbers, few remaining in either continent after the mass has flown.

The wood and stock pigeons pass and repass regularly and perhaps in large numbers, although few take advantage of the islands as resting-places. The coming and going of quail are very regular as to time, and their rarity or abundance in spring or autumn, is generally to be accounted for by the prevalence or otherwise of favourable winds. I had a great difficulty at first in accounting for the circum-

[1] Mr. Osburn found flocks of bee-eaters migrating northward in April from Lower Egypt.—*Unpub. MS.*

stance, that whenever a large flight of quails appeared, it was often on the very opposite aspect of the island one would expect them to alight at that time of the year, and the same was noticed with certain other gregarious birds. I observed, moreover, at different seasons in spring and autumn, that favourable winds rarely brought us any quail, and an absence of winds or a lull had the same effect as regards the migratory species generally, from which it may be supposed that, as long as there is no obstruction, the majority pass across the Mediterranean without making any stoppage here whatever, and only when fatigued by adverse winds. On the other hand, it is not often I observed that birds drift before the wind, perhaps for the reason that their feathers get disarranged, and that they slant, as it were, to use a nautical phrase, "with the wind on their quarter," and the Maltese believe that the quail keeps one wing motionless, and raised like a sail, and thus cross like a vessel. As to the relative proportion of migrants here in spring as compared with autumn, I have always noticed fewer at the latter season, which, however, cannot be owing to the general prevalence of northerly winds, as the south-east, or sirocco predominates then, at all events in September.

The rationale of the quail impinging on the south and east coast-line of the islands in autumn, and the north and north-west aspects in April and May, can only be accounted for in this way, that having passed the islands, the birds, tired out, get into the winds, which throw them back on the coast, for in several instances, when large flights of quail made their appearance, I invariably noticed the wind blowing strong on the shore at the time; and seldom when they arrived, was the weather clear; in fact, the stronger the sirocco or a north wind, and the denser the sea-haze,

the more likely was there to be abundance of quail, as if the flock had suddenly come on the island unawares. Quail, however, may be said to be regular "tramps," and do not in other regions systematically obey the calls of the seasons in their migrations; at all events it seems clear, as regards the South of Europe, that the bird spends the summer there, and the winter in North Africa, although doubtless, as noticed before, many remain throughout the year wherever there is food; and this is the case to a small extent as regards the Maltese islands.

I was, however, informed in Turkey that quail are common in vetch fields in July, and also in November, which shows some discrepancy in their migrations in the extreme eastern as compared with the central and western portions of the Mediterranean basin; but the quail is a bird so thoroughly dependent on man for subsistence, that its goings and comings seem regulated entirely by the seasons of the year when the crops ripen and are gathered, which of course is pretty regular as regard cereals in general; but I have noticed that the vetch plants are particularly sought after by them, and that whatever time of the year any of the various sorts are raised, quail are sure to frequent the fields in abundance, even after the majority have pushed onwards to distant countries. Sometimes in India, after the grain has been gathered, they disperse in the jungles, where, in a day's travelling, ten or more individuals may be flushed, then as the crops ripen they gather together. Besides its well-known dactylic call, "wĭt-ă-wĭt, wĭt-ă-wĭt, wĭt-ă-wĭt!" there is a sort of companion-whispering that no doubt keeps societies together on wing and on the ground, as may be observed with flights of finches and suchlike. As regards the quail, it is a low "chuk," which I have heard passing from one to another,

though the dense vetch grain covers both in India and North Africa.

The quail are at both seasons in good condition, but plumper and fatter in spring than in autumn, which I think is generally the case with all the other migrants. The far-famed Beccafico (*i.e.*, any of the warblers) is most prized immediately after its arrival from Africa, more especially the white-throat and garden warblers. I asked a Maltese poulterer how many of the latter species he might have sold during the spring season, and was told that, from his own stall and that of another opposite, he should be within the mark in supposing that about 100 dozen had been disposed of, not to mention scores of nightingales and other soft-billed birds, which are also eagerly sought after, not only by these olive-oil and pickled fish-eating islanders, but Englishmen, who, in their native country, would scorn to breakfast off "Jenny-wrens." Although I must plead to the same weakness as regards the white-throat and garden warbler, I would fain put in a word in defence of that prince of songsters, the nightingale; for it was among the fig-trees of Malta that his melodious strains first fell on my ears, and I shall never forget the scene and circumstances that brought us in contact. How often afterwards, during the few weeks he honours the islanders with his presence, have I wandered to one of his favourite haunts, and, with gun across my knees, listened for hours to his sweet voice; and, alas! far oftener has it been my lot to count his form by the dozen on the counter of the Maltese poulterer. It may be a small subject on which to moralize, but I don't think any one who can appreciate the beautiful in nature, but would feel somewhat sorry to witness such a scene, when he thinks of the hundreds of mellow throats now silenced for ever, that might

in more northern climes have gladdened the heart and aroused the finer feelings of humanity; and all for what?

Large annual migrations of the wryneck, and flocks of the red-throated pipit pass and repass annually. I have noticed shades of plumage in several of the last species, and so closely approximating its congener, the titlark, as to make it difficult at first sight to distinguish the one from the other; but apparently the two do not associate, at least during their migrations, and their call-notes are different. The first never stays in the islands beyond a few weeks, whilst the latter is resident throughout the winter months.

In dissecting the migratory birds which pass through Malta in spring, I observed that the genital organs of both sexes showed no general disposition to enlarge, unless in the black swift, linnet, and such as stop and breed in the islands, from which it may be surmised that they do not think of pairing until they gain their summer retreats, but doubtless many breed during their temporary sojourn in Africa. Judging from the comparative paucity of young birds seen in spring, as compared with their predominance over adults in autumn, it may be fairly surmised that the majority prefer to breed in Europe. The observation of Temminck, that the young birds of the season keep together during their passage, is not seemingly the case generally, at least in respect to many of the insectivorous species procured by me immediately on their arrival in Malta. Towards the end of May enormous flocks of the Spanish sparrow repair to roost in gardens and orchards, crowding on orange-trees; nearly all appear to be adult males and young birds; but as the species has two broods, doubtless the females remain on their nests at night, when the males repair to the gardens with the fledglings.

I suspect there is every year a pretty extensive migration

to and from Africa and Europe of the glossy ibis. This bird, singly or in flocks, is regular in spring and autumn, and although a very few are observed in the islands, still the punctuality would indicate that they are no accidental wanderers. As usual with its allied species of more Eastern countries, it has a predilection to keep company with other gregarious birds, such as egrets, crows and pigeons, even feeding with and following the flocks from place to place. I have rarely seen the hoopoe behind its time, either in spring or autumn. It seems to cross singly, as I have observed individuals alighting on the coast during the sirocco. Most generally it makes its appearance in Malta about the 7th of April, and again in the beginning of September. As to the cuckoo, the frequent presence of its well-known form in the market during the migratory seasons, sometimes early, and even as late as the 10th of May, together with an occasional call-note, show the regularity of its migrations. It seldom makes a lengthened stay, and perhaps individuals tarry only a few hours, for the country is in no ways inviting to the "messenger of spring." Simultaneous with the last come flocks of the golden oriole, and luckless is the advent of the few that seek a temporary resting-place on Maltese soil, for no sooner is their attractive plumage noticed than a dozen guns are put in requisition, when, if not annihilated, they are at least expelled beyond the precincts of the islands. It doubtless breeds in North Africa in winter, as many yearling birds are seen in the immature plumage. The bee-eater may be seen in spring arriving in scattered flocks, with a south-east wind, and uttering their characteristic guttural call, and flying like house-martins. I have often seen large flocks passing over the most tempting parts of the islands without any desire whatever to descend from their course.

The collared pratincole (*Glareola pratincola*) in flocks

makes its appearance in ploughed fields towards the end of May, and again in autumn. It is a regular migrant. Like the sand-grouse, it crouches on the ground, and is not easily observed until flushed; its flight and call is like that of the tern. I have dissected many, but never found other food than beetles and insects in the stomach. Several specimens compared with the so-called Pallas's pratincole furnished none of the characters given by this author as distinctive of the bird found in Greece and Central Asia.

Now and then a solitary Egyptian vulture finds its way to the islands. Thinking it a good opportunity of observing the mode of change in the plumage of the young to the adult, I procured a live specimen in its first year's garb, and kept it until it assumed the characters of the adult. The first change remarked was the gradual transition from the dark colouring of the cere and face to a faint yellow, and the legs to a reddish white, all of which took place when the bird was nearly three years old; then, without casting any feathers, a sort of marbling process began on the feathers of the back, scapulars, tail coverts, wings, tail and belly, presenting a sooty-white colour, which rapidly passed into white by the beginning of the fourth year, when the iris became reddish, as in the adult. The following spring it moulted, and by midsummer it appeared in the full garb of the male. Unless the confinement retarded the change, this would show that the bird does not come to maturity until the commencement of the fourth year.

Swallow Tribe.—The swallow tribe maintain the utmost regularity as to numbers and dates of arrival, both in spring and autumn. Often I have observed flocks of the chimney and house swallows drifting before the winds, more especially

in autumn. On one occasion I noticed, immediately before a violent hurricane from the N.E., on the 15th October 1861, as the dark masses of cloud were advancing, enormous flocks of these two birds, and counted at the same time upwards of thirty honey buzzards drifting before the wind. Again, a strong sirocco in the middle of March, or during the succeeding month, is sure to bring in swarms of swallows and black swifts. The Alpine swift is a regular visitor, but only in small numbers, and these do not linger beyond May. I have already observed that the black swift tarries in Malta throughout the summer, taking its departure early, and, not content with the genial winter climate of Northern Africa in winter, pushes perhaps farther southward than any other of its allies. I found it plentiful in Nubia and Upper Egypt, as elsewhere recorded. In none of the passenger swallows could I discern any peculiarities of plumage different from the individuals which frequent Europe. I mention this from the circumstance, already observed,[1] that the permanent race or variety of the chimney swallow which frequents Lower Egypt in winter, differs from the type bird in having the lower parts bright rufous, with the white spots on the tail feathers of the same red colour. Among the foremost pioneers of spring, the chimney, house, and sand swallows are the last to leave of all the birds of passage, lagging often to the middle of June, and until the verdure has gone, and there are no grassy lawns and green fields to invite a further stay, then, assembling in flocks, they may be seen preparing for a rush northwards; but when on their way south in September and the following month they tarry only for a short time, for the rains have not yet restored the winter green aspect to the country.

[1] Page 11.

Warblers.—The lively little chiff-chaff, contented with the winter climate, no sooner sees the fig-tree sending forth its buds in March, than, as if by magic, it vanishes from our shores, and is off to rear its young in more northern lands.[1] Its congeners, the willow, wood, and other warblers before mentioned, never stop beyond a few weeks during their migrations; and, in common with other migrants, perhaps only an iota of the numbers that cross the inland sea annually deign to make a temporary resting-place of the islands.

A few black-capped warblers tarry on their way, and I procured one specimen of the moustached warbler and hedge-sparrow, which, with the blue-throated, orphean and lesser white-throat, may be said to be quite accidental visitors. Of other uncommon or irregular migrants, I may mention the Daurian and crag swallows, of which I have seen several. Adult males of the former had the rufous spots on the tail and the rump paler than on the occiput. The crag swallow was not uncommon in December 1863 about the capital of Gozo, and possibly the species may turn out to be a resident during the cold months among the rocky

[1] What determines the departure of this and the redbreast from Malta, just at a time when neither climate nor failure of subsistence could be the inciting causes? Change of seasons, and failure of insect or other food, doubtless bring about the migrations of birds in general; but I have often thought that the periodic season, when the calls of nature compel the animal to seek a mate and a suitable locality to rear its young, act also forcibly on many species, and, in the case of the two migrants just named, I observed them mute from arrival in October up to the beginning of March, when their well-known songs were often heard. I have, moreover, dissected them at this time, and found the generative organs in both sexes enlarging, which conditions were synchronous with these manifestations of pleasure—therefore we may suppose, that as soon as they found the time had arrived for their nesting, and there being no woods, or groves, or mossy banks suited to the nidification of each, that they at once proceeded to seek for more favourable regions; but why go northwards, and not as likely to Africa?

ravines of that island, as its general resemblance to the sand-martin is likely to occasion it to be overlooked.

Myriads of turtle-doves pass over Malta with every south and east wind in April and May, and are captured in numbers by means of clap-nets and decoy birds, but only an infinitesimal number alight on the islands either in spring or in autumn.

II.—ASPECT OF THE ISLANDS IN AUTUMN.

About the last of October, Malta commences to put on her winter robe, and doff her greyish-brown garments of summer. Now it is that the grass begins to sprout, and the farmer turns up the soil; the leaf is slowly dropping off the fig, vine, and Persian lilac: thus, whilst the sap is descending in them, it is rising in the herbs of the field. The bright red fruit of the pomegranate hangs pendant from the branches, whilst the Naspoli Japonica is seen in flower, and will bear its luscious fruit in March. Again come back our spring-feathered visitors from the north, the migratory young birds of the year predominating; but the arid, sunburnt slopes in September afford nothing tempting to the passers-by, and were it not for the vegetable gardens in the valleys of the Marsa, Boschetto, and suchlike, I verily believe not one bird in a thousand would then condescend to alight on the islands. It must be the fields of cabbages, tomatoes, pumpkins, cotton, and Indian corn that tempt them, or the few fig-trees, now laden with delicious fruit; with which the market is stocked at this season.[1] It is an interest-

[1] The Maltese practise caprification extensively, by attaching the fruit of the wild fig by strings to the branches of the domesticated trees. The figs of Malta, although small, are equal in flavour to any of Southern

ing occupation for the naturalist to repair to any of these localities during the calm evenings, and witness the birds, one after another, or in flocks, descending from their lofty aërial highway, and note those which come in singly or in groups, some stooping to reconnoitre, whilst others, apparently satisfied that this is not the land they are seeking, continue onwards, and are lost to view in the sea-haze.

Autumn Migratory Birds.—The yellow wagtail (*Motacilla flava*—Linn.), which passed in myriads in spring, comes in with its summer broods, and the bird-catcher is hard at work filling his cages with hundreds, all of which will be dead and eaten before another day. The changes of plumage of this bird are perplexing, and even in a flock may be found adult individuals differing very much, some having the head black, which gave rise to the so-called *Budytes melanocephala* of Bonaparte, but this is evidently only a seasonal condition, and not always present, even in males, during the breeding season, whilst others have the tips of the feathers of the same part grey, forming the *B. cinereocapilla* of the same author; however, the majority maintain the appearances of the bird described by Linnæus, with the white super-orbital streak. Very few woodcocks stop here, but occasionally a solitary individual is procured in the more shaded ravines throughout the winter months. The great, little, and ruffed bustards are recorded by a single example of each; but the Norfolk plover (*Œdicnemus crepitans*) is a regular visitor in

the tall dikes which are made to shelter them, they furnish excellent returns. The fruit of August is called Tokarleonel (*fornites* of the Greeks), the end of September crop Tokarlanos (*cratentes* of the Greeks), while that of May is the Tokartayept or Omi. There are no less than six or seven well-marked varieties of the fruit in the islands, which are known also for the superior flavour of their oranges and lemons, the blood-orange being highly prized.

spring and autumn, representing a goodly migration of the species; also the golden plover, dottrel, ringed and little ringed dottrels are met with along the coasts. The Kentish plover was observed by Mr. Wright, who supposes it may be pretty regular in its visits at the periodical migrations.

The lapwing in small flocks, and the grey plover, are also birds of passage, and one specimen of the rare white-winged plover (*Vanellus leucurus*) was shot on the islands during my stay. Probably the curlew is a regular migrant, but few alight on the islands. The slender-billed curlew I procured several times, and consider it a regular bird of passage; the pronounced attenuated bill, if not specific, is most assuredly a race character, and must establish it at all events as a permanent variety of its very close ally, the whimbrel, which is also met with in Malta at the same season. The squacco heron is regularly seen at the same time, and a few pass through in autumn. The sandpipers have little inducement to delay on their passage, seeing the coast is rugged, with few shallow and sandy beaches, nevertheless from the regular presence annually of such as the black-tailed godwit, greenshank, common and spotted redshanks, marsh, wood, green and common sandpipers, during spring and the cold months, shows that each cross and recross the great inland sea. The ruff, curlew sandpiper, dunlin, stint and stilt are also birds of passage, whilst the rail, corncrake, spotted Baillon's and little crakes, all come and go, the water-hen and coot also. Of the gulls, the herring gull breeds, but few other species are at all regular or plentiful, excepting, perhaps, the pretty little Adriatic gull, which comes in flocks early in winter, and takes its departure before the middle of April, when the black head of the male is then completed. The common and whiskered terns appear pretty regularly in winter, and

sometimes at other seasons. The other water birds (all European) do not present the interest attached to the land species, from the want of the favouring physical aspects of the islands already noticed.

Modes of Bird Migrations.—On the 27th of February 1856, 150 miles off Cape Finisterre, I was seated in my cabin, and a canary-bird was singing at the port, when to my astonishment a willow-wren alighted on the sill, and after a few minutes flew off in a direct southerly direction. It seems clear that the little lost traveller did not come direct from England at this time of the year, but must have been blown off the coast of France or Spain or Portugal by the heavy gale of the previous day from the east. This leads me to note a few observations with reference to the so-called accuracy of birds' migrations. Gregarious migrants are more likely to secure a safe passage than such birds as perform the journey singly, for the reason that there is the combined intelligence of the flock against the one. Hence I think it will be generally found that the accidents which befall birds on their migrations refer most pointedly to such as travel singly or in small flocks. We shall never know the numbers drowned,[1] but I have noticed even the strong-winged quail and turnstones arrive on the coast of Malta so perfectly knocked-up that there was no difficulty in shooting them. One of the latter allowed me to approach within a few feet; I believe that it could not have continued much farther; the promptitude wherewith the wanderers settle down on vessels and rocks at sea attest the fact that they are often put to great straits.

[1] I have picked up bodies of spotted fly-catchers and warblers floating in the bays and creeks of Malta at their migratory seasons.

Captain Houston, of H.M.S. Duke of Wellington, informed me that one day in spring, when his vessel was about 200 miles off the coast of Egypt, there arrived enormous numbers of small birds, hawks, and owls, which settled in the rigging. All seemed very tired, and were little disposed to move excepting the hawks, which immediately began to prey on the small birds, and the officers fired several shots; still nothing seemed to frighten them, and the tired-out migrants roosted in the yards that night, and were off again on their northerly pilgrimage on the following morning. Occurrences like the above are by no means uncommon in the Mediterranean, especially in spring. It has been stated that migratory birds follow coast-lines and mountain-chains, when practicable; and as regards the former, the assertion is no doubt correct, as I shall have occasion to observe in another work with reference to the migratory birds of New Brunswick. Moreover, the Apennines may to some extent serve as guides, but, among others, I have a great belief in winds. The balmy south winds beckon them southward in autumn as soon as a failure of subsistence takes place, while boreal blasts hasten their departure; and it is just the reverse as regards temperature—other points being equal—that sends them north in spring. Much, however, depends on the nature of the food,—the insectivorous birds being the most regular as to time of departure and arrival, whilst the finches, thrushes, and suchlike, lag often to the last, and even brave the severest winters, more especially if the preceding summer had been productive of the unusually large crops of berries or fruits on which they feed. The accidental visitors met with in Europe afford another proof of the blundering of birds in their migrations and peregrinations; indeed, not only with reference to that continent, but any country where

careful note is taken. Now, by eliminating the sea-birds peculiar to the American continent, about thirty species of its land birds have been met with accidentally in Europe; and, with the exception of the purple swallow and passenger pigeon, few of the others are gregarious during their migrations, and many never migrate at all. A great deal of the chances of the bird's safety doubtless depends on whether it flies low or high. Rapacious birds, herons, ducks, geese, etc., usually perform long journeys at high elevations, whilst many of the insectivorous species, quail and wag-tails for example, hug the sea so close that I have seen them following the troughs of the waves, and larks often fly so low that in an open country, for instance on the plains of the Punjab, I have been frequently startled in autumn by flocks of the large-crested lark (*Galerida cristata*) flying at great speed, and so close to the ground that they almost flew against me as they passed. The advantages of the two methods of flying must, I suppose, be greatly in favour of the high flyers, and therefore, looking at the accidental or aberrant birds that are driven across the Atlantic, there would be a preponderance of accidental visitors among those who fly low; for the reason, that they are the most likely to lose sight of land, and the least likely to discover it, as compared with such as maintain greater elevations.

Certain owls and nightjars having no opportunity in the day-time of gaining subsistence, as may be readily supposed, must make small progress in their migrations compared with those who pick up their food on the way, and by their turning day into night must more or less retard their progress; for although they discern objects at twilight with less difficulty than other birds, this does not seemingly apply to total darkness; at all events their vision is not then to

compare in degree with diurnal birds. However, the European nightjar, although late in arriving in Northern Europe, crosses the Mediterranean in the end of February. To be high flyers must be of advantage to such birds as make their distance at night, and obviate the risks of impinging on rocks and obstacles; for example, lighthouses and cliffs, which furnish bugbears and lures to many migratory birds obliged to continue their flight all night for want of temporary resting-places.[1] In fact, the progress of a flight of migratory birds is somewhat like the march of a large army through an unknown and hostile country. The mass sweeps onwards and overcomes all difficulties, whilst some are killed by their foes and accident, or die of fatigue and starvation. Perhaps the greatest amount of casualties is occasioned by the first. Then there are stragglers from the main column, either individually, or more rarely in large flocks, of which there is no better example than the famous irruption of Pallas's sand-grouse in 1863, when vast numbers passed from north-eastern Asia across Europe to Great Britain, and likely a few may have gone still farther westward, and perished in the Atlantic. This bird has a north and south annual migration in Asia, and on the above occasion most probably deviated diametrically from its regular route. The influence of furious gales in carrying birds out to sea, and the occurrence of such during their migrations, are perhaps the chief cause of the American birds finding themselves in Europe, not to speak of the sea-birds which everywhere wander beyond their

[1] It is well known that migratory birds are often attracted at night by lighthouses, and dash themselves against them. The lighthouse-keeper on Gozo informed me that he frequently picked up dead quail and other birds that had struck against the tower at night.

> "As the beacon-blaze allures
> The bird of passage till he madly strikes
> Against it, and beats out his weary life."—*Enoch Arden.*

boundaries. Perhaps the American wanderers may be blown across during the equinoctial gales, for it is a remarkable circumstance that, with the exception of the white rump and skylark, not one strictly European land-bird is accidentally met with on the American Continent, at least as far as has been yet recorded.

Prevailing Winds.—The sirocco, although generally, is not invariably accompanied by its usual leaden-grey clouds. What is known in Malta as the "black siroc," is a strong south-east wind, with a bluish-grey haze covering the horizon. Often, then, not a cloud is visible, and at night the stars are seen shining brightly. It is noticeable how this wind affects different persons; some nervous, lymphatic constitutions appear benefited by its moisture, while stout and robust individuals feel languid and depressed. On the whole, however, it is inimical to health, for slight indispositions are aggravated thereby, and more cases of the endemic ophthalmia of the island are recorded during its prevalence in autumn than at other times. The chirpings of crickets are louder then, but this is observable in other countries at the beginning of the cold months; however, mosquitoes and flies are never more troublesome and annoying than during the prevalence of this wind. Strange, however, to say, the south-west wind of the hot months is by far more unpleasant and hotter than the sirocco, and more disliked by the natives. On the other hand, it is remarkable, that whilst the sirocco is a disagreeable wind, and often blighting the plants in the Mediterranean basin, it is said to be pleasant on the northern shores. Unlike the other prevailing currents, it seems subject to sudden lulls, when afterwards its clouds may be seen banking up in huge mountain masses on the north-west horizon,

whilst its never-failing sea-haze rapidly disappears; then electrical discharges are not unfrequent, when the huge accumulations of cloud are illuminated by flashes of sheet-lightning. Often these same clouds are borne back again from whence they came. The influence of the sirocco in wearing away the surface-rocks, more especially cliff exposures, is well seen on the south-east aspects of the island, and ditches of Valetta, where the crumbling on their surfaces, more especially of the sandstone, is very apparent. Of all the atmospheric agencies, none seem more potent in disintegrating the rocks of Malta than this wind.

I well remember a regular condition of the weather akin to that just described, in the early part of June 1865, immediately before the introduction of cholera into the islands by means of shiploads of pilgrims and fugitive Maltese from Cairo and Alexandria, where the disease was then commencing. Under ordinary occasions such appearances would not have attracted attention, but, with the almost certain prospect of the disease (as on all former occasions of a similar nature) finding its way into the islands, there appeared a highly-coloured and portentous effusion in one of the local newspapers, pointing out the state of the weather as an indication of the coming evil, but which, after all, was only what may be observed any year where cholera is unknown within many thousands of miles. Had the writer been left to enjoy his fanciful theory, no possible harm might have resulted, but Dr. Sutherland, in his Report to the Government,[1] subsequently drawn up from inquiries made by him during his visit to the islands six or seven months after the disease had totally disappeared from their shores, introduced the inaccurate observation just referred

[1] *Report on the Epidemic Cholera in the Year* 1865.—Blue-Book, p. 12.

to in support of the doctrine that the atmosphere is the means by which cholera is propagated and conveyed from place to place,—being in direct opposition to the views of those who had studied the disease in its haunts, and exhausted every available means at disposal long before his advent in Malta. Indeed it would be difficult to obtain a better example of the fallacy of mistaking regular for abnormal appearances, and associating the same with the coming of an anticipated evil; it moreover reflects on the acumen of those who, in the interests of science and truth, utilize such erroneous and improperly authenticated information.

Red-dust Showers.—One of the strangest atmospheric phenomena in connection with the Mediterranean are the red-dust showers, which have been observed at long intervals. This dust is a brick-red impalpable powder, observed also in the vicinity of the Cape de Verde isles. It seems to be always deposited by southern winds, and is occasionally so dense that ships become invisible at the distance of a quarter of a mile. I was informed of one occasion in Malta, when the decks of vessels in harbour were covered with it. Specimens of the dust examined by Ehrenberg, were found to be made up of infusoria and organisms peculiar to South America, and were therefore inferred to have been carried northward by the south-east trade-winds of that region. The question, therefore, comes to be, What are the conditions of the atmosphere which cause this dust to be deposited in the above situations? Captain Maury[1] appears to me to advance a probable answer to the question. He says, "Any circumstance which may cause the dust that ascends as a

[1] *Physical Geography of the Sea*, p. 115.

straw-coloured cloud from the Orinoco to radiate its caloric and collect moisture in the sky, may cause it to descend as a red fog in the Atlantic or Mediterranean." We might therefore suppose that the heated and parched sirocco, after passing over the burning sands of the Sahara, gets saturated with moisture as it crosses the Mediterranean, and thus brings about the deposition of the red dust.

The climate of the Maltese islands from October to May is remarkably healthy. Snow and frost are unknown, and, were it not for its bleak northerly winds,[1] which often blow fiercely for days, it would be a fitting resort for invalids suffering from pectoral complaints; but the great want of shelter, and occasional siroccos, render it unadvisable to send consumptive patients to the islands, more especially seeing that it is on the highway to the more salubrious climates of Egypt and Nubia.

[1] The asperities of climate might be very much modified by arboriculture, but unfortunately the want of surface-soil, constant moisture, and shelter, are almost insurmountable barriers; still, wherever they have been overcome, there are few temperate or tropical plants that do not flourish in Malta. The Oriental plane, Persian lilac, acacias, poplars, etc., thrive remarkably well in suitable situations. I shall presently show that there is an inexhaustible bed of marl underlying the surface-rocks, and which might be utilized to any extent in forming fields, or in propagating the growth of trees around the towns and villages.

PART III.

I.—ASPECT OF THE MALTESE ISLANDS FROM THE SEA.

THE Maltese islands appear to the traveller approaching them as long, low, and narrow strips of land broken up here and there by gaps and channels, giving them much the aspect of a small archipelago formed of many insular fragments running in a south-east and north-west direction. This is owing to their small elevation above the sea, and the deep indentations in their coast-lines; gradually, however, as the vessel draws nearer, we begin to define the true state of matters, but the high stone fences hiding the verdure give a very desolate and barren appearance to the surface.[1]

[1] One is lost in wonder to understand what the inhabitants of the numerous large towns, strewn profusely over the country, can find inviting on the bare rock; moreover, on inquiry, it will be found that the superficial area of the whole insular group does not exceed 115 square geographical miles, yet there are no less than 1248 human beings to every statute mile in Malta, and about 722 in Gozo; and whilst the former is 17 miles by 7, the latter is 9 by 5 miles in breadth. The little islands of Comino and Filfla (perfectly bare limestone-rocks) are uninhabited. The latest census (1861) give no less than 134,055 of a population, exclusive of a large garrison, fleet, and trading vessels. Indeed, to the casual observer, few islands present a less attractive exterior, more especially during the parching heat of summer, when there is an absence of anything green to relieve the eternal sunburnt and weathered mantle of grey. Such, I fear, must be the impression of the midsummer visitor; and although I do not by any means agree with Byron, who saw nothing to praise, and much to abuse, in the "military hot-house" and "cursed

Moreover, even to the eye of the casual observer, they present very much the appearance of fragments of a sea-bottom that had been upheaved and long subjected to the denuding influences of the waves as they slowly emerged from the deep; and a closer study of their physical characters furnishes more definite conclusions on this head. As will be shown in the sequel, the Maltese islands are assuredly mere fragments of what had once been an extensive sea-bottom, which, when first upheaved, formed portion of Europe and Africa, or both; and, lastly, that after oscillations of level, the greater portion was submerged, leaving only these small remnants now known to us as Malta, Gozo, and Comino.

Age and Structure of the Rock Formations.—I shall now proceed to consider the nature of the Maltese rocks, the mode of their original aggregation, mineral structure, and the displacements to which they have been subjected during periods of upheaval and depression.[1]

The rock formations of the islands belong to the Miocene period, and are composed of marine deposits. Doubtless they were formed at no very great distance from land, as the remains of such amphibious animals as the dugong, manatee,

steps of stairs," which doubtless sorely tried his lame foot, still I must confess, that beyond strategical and commercial advantages, few inducements are held forth for man to exert his energies and enterprise in attempts to reclaim their rocky surfaces; but to the naturalist they offer many intensely interesting studies both in zoological and geological sciences, and also a fair field for the antiquarian.

[1] In studying the geology of the Maltese islands, two great advantages are presented to the student, namely, the facility in reaching any point, seeing that the extreme length of the insular group, including the intervening channel between Malta and Gozo, is only twenty-nine miles; the other is the simplicity of the arrangement of the strata, the distinctive characters of which present few of the puzzling features which complicate the studies of older formations.

seals, crocodilians, etc., are met with in the strata, which are also charged with corals and corallines. The beds incline from N.E. to E.N.E., as do the Apennines and the Sicilian chains; rendering it probable that all were upheaved at the same time. The various formations present an even and conformable stratification, unless where there may be bending of strata consequent on lateral pressure during periods of upheaval or depression. All the Maltese rocks are more or less calcareous, and blend into one another so gradually, that in some cases it is difficult to say where a limestone ends and the sandstone commences. Organic remains are extremely common throughout, and the same species are pretty generally distributed through the entire series, which, taking the maximum depth of each, gives a total of about 1000 feet of thickness. Compared with other deposits of the same age, the fossil fauna assimilate more to the lower than to the middle and upper divisions of the miocene of Lyell.[1]

The following classification of the Maltese rocks is somewhat different from that originally proposed by Captain Spratt,[2] and followed by Earl Ducie, in constructing his admirable geological map of the islands; also that adopted by Dr. Wright, F.G.S.,[3] in his monograph on their fossil echinæ.

The various descriptions of deposits arrange themselves from above downwards as follows:—

1. Upper limestone.
2. Sand.
3. Marl.
4. Calcareous sandstone.
5. Lower limestone.

[1] *Elements of Geology*, p. 103.
[2] *Proceedings Geol. Soc.*, vol. iv. p. 225, and reprint 185.
[3] *Ann. and Mag. of Nat. Hist.*, vol. xv., 1855.

I shall now describe these various formations, commencing with the lower limestone at the sea-level and rising up through the series.

No. 5 Bed—Lower Limestone.—All the rocks are well exposed, more especially along the coasts, where cliff sections of nearly every bed, more especially of the lower limestone, are observable. Let the student sally forth during the delightful sunny days of winter, and wander along the beach, and he will find ample occupation for his hammer and chisel, or sail round the southern coast, and observe the mural cliffs of the lower limestone, rising several hundred feet above the level of the sea. This rock, the lowest member of the series, varies considerably in character and mineral consistence; sometimes it is compact and semi-crystalline, or granular, and made up of particles of shells, echinæ, corals, and foraminiferæ, often of a spheroidal, lamellar, or concentric structure, presenting irregular white globular nodules in a soft calcareous matrix. The last sort is the least fossiliferous, and constitutes great portions of the upper surface. The colour varies from pure white to a cream and light fawn. The more durable varieties make excellent building stones, and take a fair polish, and, in common with the harder sorts of the upper limestone, are familiarly known as Gozo marble and Maltese granite. The soft and porous varieties make fair drip-stones and filters. From Il Mara to Fommer Rih Bay, and on the south and north-west coasts of Gozo, from the gorge of Migiar Scini to Kalla Baydha, mural cliffs of lower limestone, from 300 to 400 feet in height, display an almost horizontal stratification. The moist sirocco tells effectually on their sides, and causes the softer portions to disintegrate, forming shelving precipices, where the rock-pigeon breeds, whilst the sea waves and boring shells are

slowly eating out crevices and caverns along the storm-line. The upper part of this limestone passes so gradually into the superincumbent rock, that were it not for certain organic remains, which almost invariably mark the point of transition, it would be difficult to define where the one ends and the other begins. This, however, is usually ascertained by the numbers of the saucer-shaped urchin (*Scutella subrotunda*), which is strewn about or packed in beds; also masses of a foliated organism, having the appearance of heaps of fossil leaves: this is the *Orbitiodes despansus*. On the coast, opposite the fungous[1] rock in Gozo, and on the south of Malta, also at Melleha, and top of St. Julien's Bay, etc., where the overlying beds have been worn away, there may be seen vast quantities of the first-named very characteristic and beautiful scutella. Another good locality for studying this interesting horizon of the lower limestone is along the coast from Fort Ricasoli east to Zoncor Tower, and at Il Mara, close to Har Hasan's cave, where denudation has laid bare various portions, and we are enabled to trace the transition from below upwards—from a pure compact semi-crystalline limestone to a soft white rock, and anon into the calcareous sandstone. This order, however, is not always regular; sometimes the white and soft bed passes into one composed of nodules, similar to what will be noticed presently.

These nodule seams are interesting, as they contain nearly all the fossils to be met with in the other parts of the rocks. A fragment of this nodule-bed is seen on the beach between Fort Tigne and Slima, and westward at the sea-level,

[1] So named from the lichen (*Cynomorum cocconeum*) which the Knights of St. John in the seventeenth century held to be a specific for syphilitic diseases. Accordingly many of the *demi-monde* of Valetta were banished to Gozo, where they fed on this fungus, and the repute of the drug getting spread about, it became a custom with the Knights to export it to Europe.

where the lower limestone is just appearing above water. Again, it is observed for long distances along portions of the south coast of Malta and Gozo. Its irregular-shaped dark-brown nodules are evidently fragments of deeper portions that had been torn up by the sea, and deposited on the bottom, as they contain shells and teeth of sharks; but the masses are so firmly cemented together that much care and trouble are required before the organic remains can be removed.

The lower limestone can be traced inland about the Lunatic Asylum, and from Musta along the side of the "grand fault." Here the geologist can estimate the various positions of the beds, and note the vast amount denuded. It is also well seen under Gargur, facing Madalena Bay.

The organic remains of the lower limestone are very numerous, but being most plentiful in the harder parts, are not easily removed. Teeth of the great toothed shark and another species are not uncommon, but the specimens are usually so much worn from friction, that their vetrodentine is entirely removed, giving them the appearance of fragments of whales' bones, which are common also. Teeth of a large skate belonging to the genus Myliobates, and the pavement-shaped palatine teeth of diodon, with the round button-shaped teeth of ganoid fishes, are occasionally found in the softer portions. One of the latter, of very large size, seems identical with the *Sphærodus gigas* (Agassiz). Fragments of crustacea, chiefly claws of swimming crabs, are also not rare. Of mollusca, one of the most characteristic of the formation is the cast of a huge cone-shaped shell, usually met with in the upper and softer parts. At Ras el Kala, Gozo, there is seen a remarkable bed of oysters, several feet in thickness, traversing the upper part of this rock for some distance in

the direction of a quarry. The little burrowing sponges (*Cliona*) have riddled many of the shells with small pin-hole perforations, in the same manner as is observed at the present in the recent species. A little terebratula (*T. minor*), and a close ally of the existing Mediterranean shell (*T. mediterranea*), which Dr. Denis Macdonald, F.R.S.,[1] did me the honour to name *Thecidium adamsi*, the beautiful shield-shaped urchin (*Echinolampas scutiformis*), and no less handsome little foraminiferous mollusc *Heterostegina depressa*, with the orbitiodes already noticed, may all be obtained in abundance along the coast-line east of Fort Ricasoli. These fossils seem to disappear in the superincumbent beds, and thus, with the saucer-shaped urchin just named, mark the point of transition between the limestone and the freestone, which we have now to consider.

No. 4 *Bed—Calcareous Sandstone.*—The calcareous sandstone, unlike sandstones in general, has not a granular texture, but is composed of minute flocculi of lime held together by the combined forces of cohesion and pressure. It is the most extensively exposed of all the formations, occupying fully one-half of the surfaces of both islands,[2] and is composed of divers sorts of freestone, differing in colour and consistence. The least useful variety is a light-coloured or white rock, which usually occupies the centre of the formation. Exposed surfaces of this variety have a bleached appearance. It is well seen in the large bay at Marsa Sirocco, which is entirely formed of this perishable stratum, of all

[1] *Quart. Jour. Geol. Soc.*, vol. xix. p. 517, and Davidson on *Recent and Tertiary Species of Thecidium. Annals and Mag. Nat. Hist.*, 1863.

[2] It forms the surface-rock of nearly the entire east and south-east portions of Malta, so that a line running about north through Citta Vecchia would portion off the calcareous sandstone district.

other varieties the most prone to break up and exfoliate on exposure to the waves and weather,—hence not by any means well adapted for building or architectural purposes. Moreover, it contains few fossils compared with the reddish and pale yellow varieties, from which the chief building stones, ornamental vases, and statuary are fashioned. The two latter varieties, although soft and easily broken, wear well in climates of the South, unless when exposed to vicissitudes of temperature. Dense bands and nodules of chert of a grey-brown colour, having a conchoidal fracture, are interspersed throughout the bed, sometimes in rounded masses, but oftener in veins. The reddish yellow varieties contain more iron than the pale and drab-coloured sorts. Concretionary nodules of red hematite and clay ironstone are met with occasionally interspersed throughout the bed, but in greatest abundance in the upper parts near the marl, in which they abound. It is scarcely necessary to indicate localities where the calcareous sandstone is best seen, unless the student should desire to trace its origin from below upwards, when by travelling along the coast at Fommer Rih Bay south-eastward, he will distinctly trace the passage from the lower limestone into that now under consideration, and upwards until he marks the marl lying on its upper horizon.[1] The fractures and displacements observable in the calcareous sandstone sufficiently attest the great disturbances consequent on repeated oscillations of level. This is not only apparent at the faults to be noticed presently, but also in and around Valetta, St. Paul's Bay, and elsewhere, but to a less extent inland, for example in the large quarries of Lucca. I shall now describe the nodule seams, of which four well-marked bands traverse the calcareous sandstone

[1] This is an excellent locality for the fossil-hunter.

at various levels, affording, by their positions and characteristic appearances, a fair estimate of the relative position of this bed, especially in localities where there are no cliff sections to guide us. Although the various seams are regular as to position, one, and sometimes two, may be occasionally wanting, or they may thin out to mere streaks across the bed, nevertheless, with a little observation, no difficulty will be found in determining their various positions. The *lowest* is composed of light brown irregularly-shaped nodules of variable thickness, situated, as above noticed, *i.e.*, at or about the point of junction between the lower limestone and calcareous sandstone, and at a short distance under the before-mentioned scutellar bed, and usually underlaid by a thick mass of orbitoides, as at Redum Kammieh, at the west termination of Melleha Fault, also at various points on the south-west coasts of both islands. In the quarry of lower limestone at Ras el Kala, a vein of rounded nodules of limestone traverses the rock near its surface, and about the same level with the above. The nodules differ considerably from the others in their water-worn appearance, and great firmness of their calcareous matrix, which is composed of fragments of shells of various species. Sometimes this nodule seam is represented only by a line of broken shells running along the face of the cliff. As to the mineral composition of the nodules (as before stated), they seem to be merely detached portions of the underlying rock, washed and worn by marine action, and deposited in lines by currents and waves, as they agree both in composition, and contain the fossils peculiar to the lower limestone. In fact, there were no organic remains discovered by me in any of the two lower formations that were not also found in these nodule seams. From twenty-four to forty feet above the last, and occupying a prominent position in

the freestone, is another nodule seam formed of irregularly-shaped calcareous masses of a dark-brown colour, firmly united by a cement composed of particles of the nodules, and those of the parent rock crowded together without any regularity, the whole reposing on a surface broken up by pot-holes and crevices, into which the nodules are intruded as if they had received their configuration from having been deposited there. The irregular surface of this nodule-bed is exactly similar to the condition of a sea-worn bottom, perforated by boring shells and echinæ, and might represent shallow water and periods of prolonged tranquillity, similar to what attain along the present littoral zone of the islands. The pectens, so characteristic of the calcareous sandstone and the Maltese strata, generally are common, besides several beautiful echinæ, amongst others, *Brissopsis gratiloupi;* but the hardness of the matrix makes it difficult to extract them. Sharks' teeth are also met with, but not so plentiful as in another seam higher up. The above varies from one to four feet in depth, and may be studied on the shore westward of Gozo lighthouse.

About the middle of the calcareous sandstone a few scattered nodules of a light green extend in broken lines in the pale bluish-white freestone. They often appear as only mere streaks or indications of a nodule band, and in certain cliff sections seem to be entirely wanting. The most interesting of all, counting from below upwards, is the *Third Nodule bed,* which usually overlies a pale freestone, and is about thirty feet above the last. It is in general readily distinguished, not only from its position, but the small round nodules, and their loose arrangement and numbers. They are usually of a brown colour, and evidently, like the others, derived from the parent rock. The thickness of this

seam is often three to four feet; it abounds with organic remains, viz.:—cetacean bones (chiefly ribs), and also sharks' teeth.[1] The fourth and last nodule band passes through a fawn-coloured freestone about eight feet above the last. Its nodules are similar to those of the second seam, but are far more sparsely distributed, and apparently not always present. Little oblong shell-casts of a brown colour, with a pointed apex (*Vaginella depressa*), and hemp-seed-like casts of Hyalea are extremely abundant. Besides the above, lines of broken shells are often observed running across all the beds at various levels, or packed in masses here and there. Nodules of iron pyrites are abundant, and sulphur in small quantities; however, the latter is rarely found pure. From the pell-mell arrangement of the fossils and worn aspect of the nodules forming these bands, it may be surmised that they represent periods of rest, and sea-bottoms of inconsiderable depth, where the denizens of littoral zones and deeper parts had been washed by waves or deposited by oceanic currents.

Among the many interesting fossil remains found in the calcareous sandstone, teeth of the great extinct carnivorous whale Zeuglodon were discovered by Scilla.[2] A tooth of that remarkable amphibious mammal Halitheium,[3] also an ear-bone and vertebra, possibly of the same animal, were found by me near Melleha village; besides, several teeth of seal allied to the existing species were discovered in Gozo. A new genus of fishes with lacertine teeth was dug out of

[1] The cliffs running north-west from Emthaleb are among the best situations to obtain views of these nodule seams. Here I frequently dug out of the nodule band just described upwards of a dozen beautiful specimens of sharks' teeth in the course of a forenoon.

[2] *De Corporibus Marinis*, 1747, Tab. xii. fig. 1.

[3] *Quart. Jour. Geol. Soc.*, vol. xxii. p. 595.

the quarries at Lucca, which I forwarded to Professor Owen, who has named it *Stereodon melitensis.*[1]

Jaws of undetermined crocodilians, similar to the existing gavials of India, are occasionally found, and besides the various species of sharks noticed elsewhere, fish-bones of the size and shape of a large pear, with a process and small indentation on one side, being a concretionary appendage commonly found on the vertebral processes and ribs, especially in the Platal fishes. Similar bones are common on the Norwich and Woodbridge Crags (Red Crag), and are considered by Agassiz to belong to a fish named *Platax woodwardii.* Several specimens of these were found by me near St. Paul's Bay, and afterwards determined by the late Mr. S. P. Woodward.

Of all molluscs the genus Pecten furnishes the most numerous list of species; there are also others belonging to the genera *Clavegella,* besides *Scalaria ducei et retusa, Nautilus zic-zac, Terebratula ampulla, Spondylus quinquecostatus, Terebratula caput serpentis;* and species belonging to the genera *Natica, Olivia, Conus, Isocardia, Voluta, Trochus, Solarium, Dolium,* and *Ostrea boblayei et virleti.* But the radiata far outnumber any of the other forms, both in variety and beauty, and comprise many species figured and described in the author's and Mr. Wright's paper on Maltese Echinoderms,[2] and a previous memoir by Mr. Wright,[3] to both of which the student is referred. Also to Mr. Davidson's able memoir on the Maltese Brachiopoda, published in the Annals and Magazine of Natural History.[4] Cuttle-

[1] *Geological Magazine,* 1864.
[2] *Quart. Jour. Geol. Soc.,* vol. xx. p. 470.
[3] *Annals and Mag. Nat. History,* vol. xv., 1855.
[4] *Op. cit.*

fishes of various species have left their impressions and bones in numbers throughout this rock, and besides the pretty little Nautilus just mentioned casts of one or more species of very large size are to be met with. Barnacles of various sorts are plentiful, besides, shapes of what had evidently been sea-plants abound in various situations. There will be no difficulty on the part of the ardent student in finding out many new species, more especially in the nodule-beds, which in general are of easy access, and will amply repay both his time and trouble.

According to Dr. Davy,[1] the calcareous sandstone is capable of absorbing and retaining about one-sixth of its weight of water, which it gives off slowly in dry air, and about the same results attended similar experiments made by me. The sandstone must therefore be considered objectionable as a foundation, unless the surface is thickly coated with cement. One can imagine the evil results to health from making drains and sewer-ways through such a porous foundation, and readily understand the origin of the disagreeable smells which assail the olfactory nerves in many of the large cities of the islands as being the result of foul emanations from a rock saturated with the sewage of many centuries.

No. 3 *Bed—Marl.*—The point of transition between the calcareous sandstone and the superincumbent marl is often abrupt, as if the sea of the period had become suddenly charged with mud, which had been deposited for the most part slowly. The marl contains always a large percentage of lime, but differs in the amount according to circumstances. Davy found 100 parts contained 24 of carbonate of lime, 69

[1] *Notes and Observations on the Ionian Islands and Malta.*

clay (being a mixture of alumina and fine siliceous sand), with one part of peroxide of iron, and a trace of magnesia. It varies in colour from a dark blue or drab to a light brown and grey; some sorts form a fair plastic clay, being both stiff and tenacious—the light-coloured variety often running in the form of horizontal bands through the bed.[1] No doubt the extensive denudation of the marl in Malta, and to a less extent in Gozo, has been brought about by a combination of causes, but chiefly by the sea during the oscillations of level, whilst atmospheric influences continue their work of destruction at a quicker rate than ordinarily observed elsewhere. On certain of the flat-topped hills of Gozo the marl has been swept away, so that the superincumbent limestone is resting on the calcareous sandstone.

During the violent rains in autumn and winter vast quantities are borne down the slopes, and discolour the sea for some distance around the coasts. Again, on the south-western cliffs of Malta and highlands of Gozo, the rain penetrating the bed causes it to swell out; and the pressure of the other deposits overlying it, forces large masses to be ejected in the shape of heaps, which have all the appearance of having been carted over the cliffs. On that account a complete section is rarely seen, consequently the thickness of the bed is not easily determined. These crumbling accumulations (mostly from their shape and situation) led Dolomieu and the older geologists to fancy they had been washed by the sea into their present situations from higher levels. Nodules of a fine ochreous-coloured clay[2] occasionally seen lying loosely about in the marl are usually perforated by pholad borings,—casts of the latter being frequently found

[1] This is very apparent in cliff exposures.

[2] This is probably the St. Paul's earth referred to at p. 76.

in the interior. This clay adheres to the tongue when dried, and effervesces readily with acid.

From many carefully conducted measurements I have found the thickness of the marl to exceed 20 feet; its average depth, however, might be from 12 to 15 feet. The fossils of this bed are not so well preserved as in the last formation, and in the sand-bed immediately above the marl; however, bones of whales, sharks' teeth, and teeth and spines of rays, and other species of fishes, are not uncommon. A small cuttle-fish has left its bone in vast numbers, besides numerous molluscs of species identical with those already mentioned in the freestone. The greater portion of the organic remains is incrusted with peroxide of iron and gypsum; the latter strews the surface of the heaps, where beautiful specimens of the crystalline and lamellar varieties may be obtained.

Were it not for the retentive nature of the marl, these islands could not have supported so large a population, considering that whatever fertility the soil possesses is mainly due to the marl; for the rain-fall, percolating the overlying strata, comes to the marl, where it is either retained or oozes out at the point of junction between it and the sand-bed above. At this latter level the natives run in tunnels to collect water for irrigation, and from the same situation the great aqueducts which for over 200 years, and from a distance of eight miles, have furnished the chief water-supply to Valetta and its neighbouring cities and valleys. Thus the water supply of Valetta might be quadrupled without much trouble, and with a certainty which all other modes could not hold forth with any prospect of success. I shall recur to this important subject when I come to consider the alluvial formations.

No. 2 Bed—Sand.—The transition from the marl to the sand-bed above it is often very gradual, and scarcely in any cases well defined. The marl usually passes into an indurated sand, composed of black, green, brown, and red particles, intermixed and distinctly stratified in places, forming variegated reddish bands. The mineral characters of their components were submitted to Professor Rupert Jones, F.G.S., and he informs me that the black grains are composed of glauconite, and the white possibly felspar, topaz, etc. Sections of this variety, from 30 to 40 feet in depth, may be seen on the hill of Chelmus and elsewhere; but it is subject to much diversity as regards thickness, as will be observed on the western cliffs of Malta. Another variety is formed by the above passing rapidly into a red sand, or even a firm red and yellow calcareous sandstone, which blends with the superincumbent red limestone, rendering the point of junction between the sand-bed and the upper limestone almost imperceptible. The ravines of Emthaleb, Ramla Bay Gozo, and the cliffs[1] under the little chapel of Madalena, south of the village of Dingli, are good situations for the study of this description of the sand bed. In the latter situation most perfect and beautiful specimens may be obtained of the turreted urchin (*Clypeaster altus*) and the broad dome-shaped species, with its undulating margins (*C. marginatus*). The magnificent semi-spherical *Conoclypus plagiosomus*,[2] and many

[1] Here there are red cliffs fifty feet in height, and charged with numerous most perfect and beautiful specimens of echinæ.

[2] *Apropos* of this urchin and its polysyllabic name: During and for a long time previous to my sojourn in Malta, there lived on the island of Gozo one of nature's palæontologists! He usually passed under the sobriquet of "Blind Michael," in consequence of having lost one eye in early life from small-pox, and from an opacity on the front of the other had long been compelled to look askance when examining objects. This

more echinæ and molluscs, abound. I found a large part of a whale's jaw in the black sand on the hill of Chelmus. Some of the red cliffs, as in the former situation, seem almost entirely composed of the little flat foraminiferous mollusc *Heterostegina depressa*, lying in layers often conformable with the bedding of the formation; and sometimes packed in oblong or rounded masses, as if filling up cavities formerly occupied

disciple of the hammer and chisel was most assiduous in his researches after fossil teeth of sharks, or, as he designated them, "St. Paul's tongues," which, along with other petrifications, were disposed of by him to overland passengers and tourists. Thus, by dint of that experience which the necessities of his misfortune suggested, blind Michael, when digging out a tooth or urchin from the rock, always gave it a very wide berth in case that one of his many erring strokes might rend the object in twain. Between myself and Michael there grew up an understanding that on his arrival in Valetta with his antediluvian wares, he was invariably to repair to my house in order to have them overhauled for rarities. I well remember one occasion, when Michael, as usual, barefooted and in his shirt-sleeves, appeared at my door heavily laden with specimens, among others most perfect ones of that above-named. Collectively all fossils were classed by him under the title of "Adam," from a general belief among his countrymen that they referred to the earliest recorded period of man's existence, but Michael liked to catch up the English appellations also, and made much show of his knowledge on this head to his customers. Although assured that the English language had no name sufficiently characteristic of the urchin in question, he would persist in his inquiry, when I repeated in measured syllables Co-no-clyp-us Plag-ios-om-us. At which Michael, casting the blighted orbs heavenward, with a sly grin on his weatherbeaten countenance, exclaimed, "Jesu Maria! how me remember that?" Nevertheless blind Michael knew the local geology far more intimately than better lettered men, and although the æsthetic faculty, as in Peter Bell, was not by any means strong in him, so that "a fossil on the shelving shore" was "to him a fossil and nothing more," still he had acquired a very practical knowledge of the various localities where the choicest natural objects were to be obtained, and now when I think of the valued assistance I have received from him in collecting many of the interesting specimens which have since found their ways to the cabinets of the Geological Society of London, I cannot help according some credit on that account to my old companion, "Blind Michael of Gozo."

by sea-weeds. The dark sand furnishes abundance of sharks' teeth, which, however, seem to terminate abruptly at its upper horizon.

No. 1 *Bed—Upper Limestone.*—As just remarked, it is often impossible to define the limits between the sand-bed and the superincumbent formation which I have named the *upper limestone.* Sometimes the former merges gradually into a hard red limestone, composed of corals and corallines, as is visible in many of the Gozo eminences, or on the southern cliffs of Malta, where the dark-coloured sand passes almost imperceptibly into a coralline limestone, varying from a reddish white to a dark bluish white, which in its turn passes into white limestone; and as the corallines disappear we find a white calcareous sandstone about the centre of the bed, as on the cliffs west of Citta Vecchia, and finally, uppermost of all, an open-grained rubbly and white limestone, formed of casts of shells, and filled with fissures and cavities. Weathered and detached masses of this rock in the shape of boulders, strew the valley to the east of the lighthouse of Gozo. Being hard, and containing abundance of fossils, these blocks afford a good polish, and, in common with the marbly varieties of the lower limestone, are known to the Maltese lapidary as Gozo marble, and are used extensively in making grave-stones. This order of succession of the upper limestone is not invariable, although in general the varieties maintain the above arrangement. Next to the calcareous sandstone the upper limestone is the most extensively exposed; it covers almost the entire south-west and north-west portions of Malta. The island of Comino is entirely composed of it, presenting cliffs 200 feet and upwards above the sea. It forms a capping to nearly all

the isolated hills of Gozo. The same denuding forces that acted so powerfully on the other beds, have worn away great portions of the upper limestone, so that nowhere is its original thickness preserved. On several of the Gozo hills the only portion *in situ* is a fragment of red limestone capping the rounded heaps of sand and marl, which are rapidly melting away and being conveyed by the winter rain down the ravines into the sea, whilst large masses of the former are toppling over, as on the hills of Dabrani and Dibiegi, so that the heights of the highlands of Gozo have been lessened some thirty feet within the memory of the present generation; indeed, it is clear that all these isolated eminences are rapidly melting away. Dibiegi, however, still maintains the sovereignty over the other hills of that island, but from the degradation taking place, it is probable that its upper beds will soon disappear. The mean of many aneroid measurements made by the author and Captain Swann, F.G.S., in 1864 and 1865, gave 743 feet to Dibiegi, and the average of repeated calculations fixed the square of Rabatto, in Gozo, at 258 feet above the level of the sea. In Malta, a rising ground near the coast to the south, and within a short distance of Casal Dingli, is but a few feet higher than Tower Nadur, in the Benjemma plateau, and is the most elevated portion of the islands. The mean of ten aneroid measurements gave 750 feet as the height of this locality above the sea. I mention these data chiefly on account of an exaggerated statement in a work seemingly of much merit, in which the highest point in the islands is recorded as even 1200 feet above the sea.[1] The fossils of the upper limestone are exceedingly numerous, the only difference being

[1] *History of the British Possessions*, by M. Martin, British Colonial Library, vol. vii.

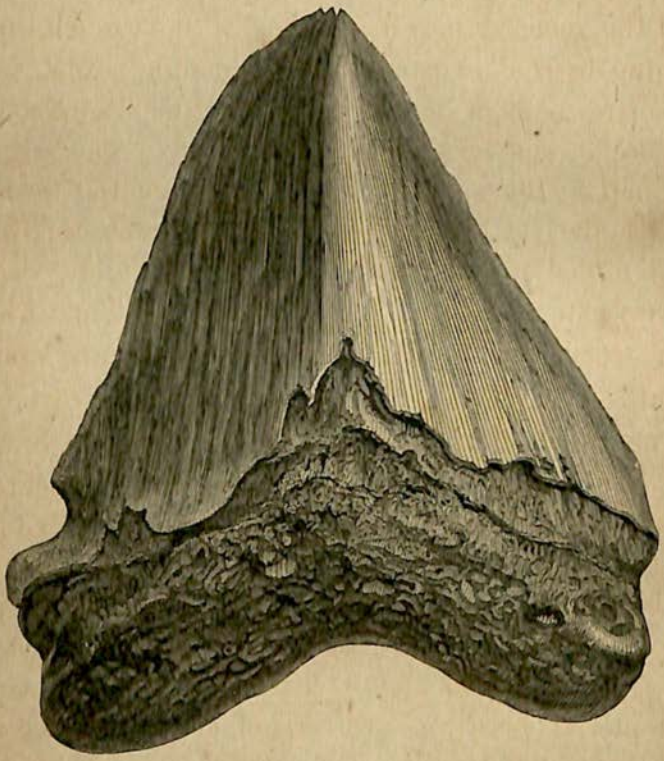
that fewer remains of the higher orders of animals are met with than in the underlying beds; but the molluscs and echinæ are exceedingly plentiful, and frequently discovered in admirable states of preservation. The pretty little urchin (*Cidaris melitensis*), sometimes with its spines attached, is very common; also the great scallop (*Pecten quinquecostatus*); that fine pentagonal and elevated test, *Clypeaster redii*, is occasionally observed, besides several species of the flat oval-shaped *brissi*, and other radiata, are plentiful. With Mr. Wright's able memoirs in hand, the student will find no difficulty in making out their names. Let him wander along the crumbling cliffs on the southern coast of Malta, among the shelving masses and fallen boulders, and, when he has exhausted the stores in one given spot, descend to the sand-bed below, or, lower still, to the marl-heaps; anon down the slope covered with masses of rock or little cultivated fields of vetch, to the outcroppings of the calcareous sandstone and its seams, until brought to a standstill by the sheer cliffs of the lower limestone with the Mediterranean hundreds of feet below.

The various formations, and their subdivisions, together with the localities where the particular strata are best seen, are enumerated in the following table :—

No. 1. Upper Limestone, greatest depth 250 ft.	White rubbly limestone. Coarse-grained sandstone. White or grey-brown bed. Red coralline stratum.
No. 2. Sand, greatest depth 60 ft.	Red or yellow indurated rock. Black, with red patches, sand. Black-grained sand.
No. 3. Marl, greatest depth 100 ft.	Blue clay, with lighter coloured bands.
No. 4. Calcareous Sandstone, greatest depth 200 ft.	Pale grey rock. Nodule seam. Fawn-coloured rock, with nodules of selenite. Nodule seam. Irregular bands of green-coloured nodules. Pale red or bluish rock. White rock, with chert nodules, then a seam of nodules, and lowermost a pale yellow sandstone.
No. 5. Lower Limestone, greatest depth above sea 400 ft.	Transition or scutella bed. Nodule seam. Concretionary and oolitic limestone. Irregularly compact, sometimes semi-crystalline.

The greatest developments of the beds are to be seen at the following localities:—No. 1. Cliffs of Comino and western termination of the southern fault, called Malak Fault. No. 2. Hill of Chelmus; cliffs south-west of Dingli. No. 3. Cliffs at Karabba. No. 4. Cliffs north-west of Fommer Rih Bay. No. 5. Cliff at entrance of Zurrico Gorge.

Fossil Sharks.—Of all the fossil marine vertebrata, none seem to have been more numerous or characteristic of the Eocene and Miocene periods than the sharks. Enormous numbers of their teeth are constantly turning up in Malta, more especially in the calcareous sandstone. I have met with a very few specimens in the lower limestone, and



One-half Natural Size.

TOOTH OF THE GREAT-TOOTHED SHARK (*Carcharodon megalodon*).—Page 139

searched in vain for a trace of the family in the upper limestone. We find them in all the other beds, but most commonly in that just mentioned and the sand bed, as if the highly calcareous sea bottoms were inimical to their habits, whilst clay and arenaceous deposits favoured their existence. Foremost of the many species is the great toothed shark (*Carcharodon megalodon*). Magnificent specimens of the teeth of this monster may be obtained without much trouble by digging in the sandstone and its nodule seams, where they are strewn about in the greatest possible disorder, along with those of smaller sharks, molluscs, etc. This gigantic animal, happily now extinct, must have been the terror of the seas and river estuaries, and from its presence in the miocene formations of the Old and New Worlds, was no doubt very extensively distributed, and, not content with the ocean, it seems, like its existing congeners, to have haunted the mouths of rivers, as its teeth were lately discovered in fresh-water deposits at Namur on the Maas.[1]

Single specimens of teeth found in Malta measured 7 inches in length. One discovered in the black grained stratum of the sand bed (*see* Vignette, page 74) was $6\frac{3}{10}$ along its triangular margin,[2] with a base of $4\frac{5}{10}$ inches, and a perpendicular height equal to $5\frac{3}{10}$ inches; its greatest thickness being $1\frac{3}{10}$ inches. This almost exactly equals one I saw in the museum of Berne, in Switzerland, and others recorded from the miocene deposits of North America. Such individual teeth are, however, rare, the average being not nearly so large. The triangular outline of the tooth is of course either slightly bent inwards at the tip, or to one side, accord-

[1] *L'Institut*, October 28, 1863.

[2] In Boisgelin's *Malta* there is an account of a specimen measuring 7 inches along its side.

ing to the position in the jaw, and occasionally specimens may be found almost twisted like a cork-screw.[1]

Teeth more frequent, but not so broad as the last, with two facets at the base, and agreeing with the *Carcharias productus* of Agassiz, are also common in the same situations. Another highly carnivorous tooth of a much smaller shark than either of the above, with the serrations on the sides more deeply trenchant, is associated in vast quantities with them. The largest specimens I have seen measured 1 inch in height, with a base of $1\frac{2}{12}$ inches; the average, however, are considerably smaller; it is the *Hemipristis serra*, and distinguished from a close ally, the *H. paucidens*, the serrations of which are confined to the upper part of the tooth. The two last are rare, excepting in the nodule beds of the sandstone, where the hook-toothed shark (*Corax aduncus*) is still less plentiful; its curving point, with a few deep serrations, suffice to distinguish this little tooth. Triangular and

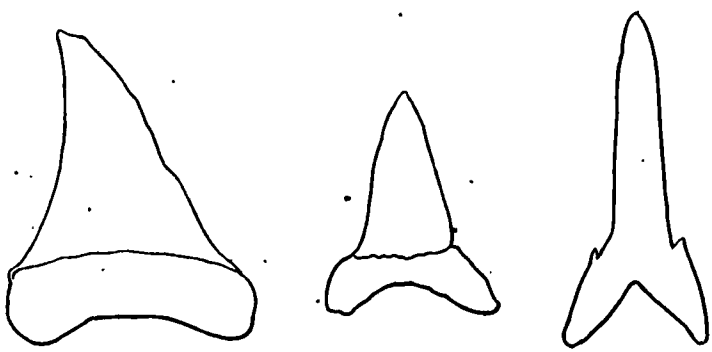


FIG. 1. FIG. 2. FIG. 3.

almost even margined teeth, belonging to *Oxyrhina Xiphodon* (Fig. 1) and *O. hastilis* (Fig. 2), are exceedingly abundant in all, excepting the uppermost bed. The awl-shaped one

[1] The native name, "St. Paul's tongues," is from a superstition that they were connected in some way with the Apostle's visit to the island.

belonging to *Lamna elegans* (Fig. 3), with its two small appendages at the base, is very rare. I have only met with one or two specimens in the nodule beds. The allied form of tooth named (*Odontaspis hopei*) is seemingly represented amongst the Maltese fossil sharks, but in all the specimens I procured its little toothlets were wanting. Doubtless teeth of other sharks will be found, more especially in the situations indicated above.

INDICATIONS OF UPHEAVAL AND DEPRESSION.

ONCE familiar with the structure and stratigraphical distribution of the various beds, there can be no difficulty in finding out their displacements. These are amply attested by many well-marked "faults," besides numerous rents which traverse the islands in various directions.[1] Such memorials of bygone disturbance, when associated with the facts before mentioned, and others I shall now detail, do most assuredly point to a time when the Maltese group formed a portion of a land connected with Europe and Africa.

Faults.—Grand Fault.—I will now point out the most prominent displacements of the beds, which before the subterranean forces acted on them must have been nearly if not absolutely horizontal. An excellent bird's-eye view of the physical geography and geology of the depressed portion of the insular groups may be obtained from the cliffs overlooking Fommer Rih Bay on the west coast of Malta. As the traveller turns a corner of the road which runs across the Benjemma heights, there bursts on his view a pretty and rather imposing scene. In the distance the bluffs of lower

[1] For the discovery of the great fault and the first clear exposition of the geology of the islands we are indebted to Captain Spratt, C.B., R.N.; *Proc. Geol. Soc. Lon.*, vol. iv. p. 225, 1843.

limestone are seen fringing the west and north-west sides of Gozo, and rising in sheer cliffs which decrease in altitude eastward to Migiar Scini gorge, where, as seen in the map, the Grand Fault has its western termination. He will mark the strange-shaped hills of Gozo with their limestone cappings; then as the eye wanders along the western coast-line of Malta from one little bay to another, with their dark crumbling banks of marl and surface rock of upper limestone, from which detached masses have rolled down the slope, and act as barriers, and in a measure retard the advancement of the sea on the coast, a fair estimate may be formed of the extent of the force or forces that brought the upper member of the series to such unequal levels. For example, that on which he is standing, and the depressed land several hundreds of feet below him, just as if Atlas had raised the entire island group to the level of the plateau, when a large portion in the middle gave way and sank, leaving the remainder of Malta, south-eastward, and that of Gozo, beyond the gorge just named, at much about the same levels. Such is the aspect of this displacement as seen from a commanding position. On closer inspection it will be found clearly defined by well-marked and almost vertical escarpments, which can be clearly traced across the islands, with their opposing faces polished and striated. Commencing at the western termination of the Grand Fault on the coast in Fommer Rih Bay, the upper limestone will be seen to be still the surface formation, but instead of being at the level of the same rock on the plateau above it, is now low down and subtending the calcareous sandstone. On following the line of fault across the island, there will be no difficulty in noting the extent of the depression and amount of denudation of the upper beds.

It will be seen, therefore, that this fault runs across the entire breadth of Malta, from Fommer Rih Bay to Madalena Bay on the north-east coast, where the lower limestone and greater portion of the calcareous sandstone are entirely submerged under the sea. Thus the lateral direction of the submerged portion of this depressed land would run about north-east and south-west. Such are the phenomena observed at these points.

Proceeding northwards along the long axis of the depressed portion, the geologist will note the extensive denudations of the upper strata in the Nasciar Valley, and can speculate on the extent and duration of the forces sufficient to have cleared away hundreds of feet of solid strata.

Faults in St. Paul's Bay.—Here other displacements and still further depressions have formed the harbour and valley, said to have been the scene of St. Paul's shipwreck.[1]

Thus it will be seen on reference to the map that one slip near Tower St. Paul subtends another through the islet of Selmunet, where the Apostle's vessel is supposed to have struck. Now looking downwards on the bay and valley, with their sloping cliffs of limestone, it will be evident that here we have a local depression in the already sunken area, so that the upper limestone along the lines of fault is opposed by the calcareous sandstone. But neither of these two small faults cross the island, as will be apparent by examining the cliffs on the west coast.

Faults in Melleha Valley.—Continuing on to this bay, similar downthrows are evident, having escarpments on

[1] The "place where two seas met" may have been the Straits of Frioul between the two islands, which, to a boat approaching from the north-west, would look like a channel communicating with two oceans.

each side, and running, one about two-thirds, whilst the other extends from coast to coast. Still onwards towards the north-west end of Malta, over the bare upper limestone now gradually sloping to the sea level, we arrive at Marfra, where the upper limestone becomes submerged. The island of Comino, however, shows from the high cliffs of the rock that the general submergence was unequal.

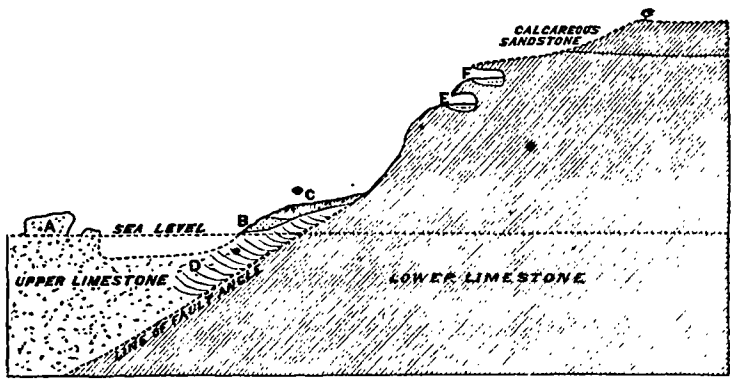
Gozo end of the Grand Fault.—Crossing the Straits of Frioul to Chambray in Gozo, and making for the gorge of Migiar Scini, we follow the line of downthrow under the picturesquely situated village of Nadur to the brow of the hill, where its hitherto north-easterly course suddenly changes towards the south, and the fault with two branches is seen running into the sea near the little chapel opposite the rock called Blat el Kinci and Fort St. Nicholas in the island of Comino.[1] This is the north-western end of the Grand Fault, which we have thus traced across Malta, and it now becomes clear that the smaller rents at St. Paul's and Melleha Bays are but secondary faults through the great central depressed portion; the greatest amount of depression, as a matter of course, being between Marfra and Gozo, where the beds are entirely submerged.

Malak Fault.—Another important downthrow is to be seen on the southern coast of Malta, extending for upwards

[1] This fault brings the upper limestone to a level with the lower limestone at its western termination in Migiar Scini, whilst the former subtends the lower part of the calcareous sandstone below the village of Nadur, diminishing in the extent of depression towards its north-eastern termination, so that the depressed portion is not under the level of the upper limestone of the upraised side. Captain Spratt describes the east end of this fault as passing down Wied dahlet Korrot into the bay of Scilech (*Op. cit.* and *map*); until carefully surveyed, the appearance at first sight indicates this course.

of two miles, from Ras-el-Bajada to a promontory below St. Giorgio (Figs. 1 and 2).[1] This important displacement is not shown by Captain Spratt, nor in the geological map of Earl Ducie. It comprises a low stony flat of upper limestone sloping towards the sea, with its eastern surface more or less covered with red earth, for the most part hardened by

FIG. 1.—Vertical Section of the Coast showing the positions of the Middle and Mnaidra Caves with reference to the Malak Fault and fossiliferous deposit thereon.



A. Islet of Filfla, composed of the Upper Limestone.
B. Breccia and red earth containing fossil remains of elephants.
C. Modern Alluvium covering B.
D. Bent and contorted strata consequent on the downthrow.
E. Section of Middle Cave.
F. Section of Mnaidra Gap.

calcareous infiltrations, thus forming a fine breccia in many places. In the various coves and indentations along its coast, there will be no difficulty in making out the underlying marl and calcareous sandstone, together with "slick in sides," more or less finely polished, and running at high angles ranging from sixty to eighty-five degrees. This is well seen at its western extremity, where a cliff of

[1] An excellent view of this important downthrow is represented on Fig. 2, p. 174, for which I am indebted to my friend Captain Goff, 15th Regiment.

the upper limestone, fully 230 feet in height, terminates the displacement in that direction. It may be fairly conjectured that the submerged land, of which this depressed portion is a remnant, stretched in a southerly direction, as the islet of Filfla, distant only three miles, forms an "outlier," being comprised of the upper limestone with a fragment of the underlying marl and sand beds appearing above the sea-level. Of all the other displacements this fault shows the greatest amount of depression (above the sea-level), for the upper limestone is fully 200 feet below the upper horizon of the lower limestone; moreover, the crushed and smashed appearance of the upper limestone on the downthrow testify to the extent and perhaps violence of the disturbing agencies which brought about the displacement. As will be shown in the sequel, it was among the red earth and breccias on the surface of this downthrow, and in the caves and fissures on the cliffs of the lower limestone immediately above it, that I met with abundant remains of extinct quadrupeds, reptiles, birds, etc.

Here the geologist, standing on the bare limestone cliff, and looking across the deep blue waters of the Mediterranean, might speculate on a time when Malta was portion of a continent extending far far beyond the misty horizon,—of a land abounding with mountains, rivers, lakes, woods, and forests, where strange pigmy elephants kept company with gigantic compeers, and where also river-horses in hundreds and thousands lived and died; of myriads of destructive rodents, huge fresh-water tortoises, and aquatic birds swarmed on the land or on the water; how, perchance, for unreckoned ages had all sojourned in safety on this ancient post-miocene land, until suddenly (it may be by degrees) it began to sink below them, and they were finally cut off from both continents; then, dying by starvation, they

crowded together, and as pinnacle after pinnacle of rock was disappearing under the waves, boisterous billows washed their carcasses into the hollows and rock fissures where we now find them.[1] This is also a fitting locality for the antiquarian; for looking landwards, on the bare weather-worn rocky slope, the Stonehenge-like ruins of Hhagiar Kim and Mnaidra rear their solitary and rough-hewn blocks, which seem to bid defiance to time as they challenge the archæologist to find out who fashioned them and placed them in their present situations.

Minor Faults and Fissures.—The lesser faults and localized depressions, such as the pit-like sinking called Macluba,[2] near Krendi, and the crater-shaped hollow close to the fungous rock in Gozo, or even the slips and downthrows visible in the harbours of Valetta, St. Julien's, and St. George's Bay, are all evidently remnants of faults now submerged; indeed, the evidences of sinking are visible at almost every point along the shores of both islands, showing that the original coast-line has not been preserved anywhere, whilst the high angles of the faults seem to demonstrate that the forces acted in an almost vertical direction, causing much lateral pressure, and forming synclinal undulations, as are observable at St. Paul's and Melleha Bays.

Soundings.—From soundings made by Admiral Smythe and Captain Spratt,[3] it appears that an elevation of the sea-

[1] Such is a likely enough mode by which they may have been entombed, but it will be shown in the sequel that land-floods, such as obtain occasionally on the area at the present day, are equal to have conveyed fragments or even carcases of elephants for long distances.

[2] The Maltese have a tradition that this was the site of a village, the inhabitants of which were very godless, and in consequence were swallowed up in one night by an earthquake.

[3] *Quar. Jour. Geol. Soc. Lond.*, vol. xxiii. p. 283.

bottom to the extent of 250 fathoms between the Maltese islands and Africa on the one side, and Europe on the other, would connect the islands with Sicily, Italy, and Tripoli by narrow ridges or strips of land, broken by two narrow channels, which Captain Spratt considers would not, however, be impassable to land and amphibious animals, such as the elephant.[1] Accordingly he is disposed to consider the submerged land was but a mere highway across the inland sea; but the inequalities in the amount and degree of subsidences and elevations pointed out in Malta, render it highly probable that the same conditions are presented on the bed of the Mediterranean, and perhaps to a far greater extent; further, we must bear in mind that often when one portion of land is rising another is sinking, and that the present bottom of the Mediterranean may have undergone several mutations since the first depression of the original post-miocene area, of which Malta is a fragment; moreover, the vast numbers of river-horses, elephants, voracious rodents, and fresh-water tortoises constantly turning up of late years in the caves and rock fissures of the islands, and also Sicily, with its richer stores of a similar description, dispose me to believe that, in order to have maintained so numerous a fauna, there must have been a greater lateral

[1] According to Captain Spratt's chart, *op. cit.* p. 293, his so-called narrow channels would seem to be *each at least* five miles broad! Now the elephant has a strong aversion to go beyond his depth, and also carnivorés, such as the hyæna, not to speak of the rodents, etc.; even the hippopotamus, although said to be found at the mouths of West African rivers, is not likely to have herded along such a long narrow roadway as Captain Spratt supposes; thus clearing regularly two straits so broad that he could with difficulty descry land from the opposite shore,—I agree with Dr. Falconer (*Palæontological Memoirs*, vol. ii. p. 301), that at this time "there must have been continuity of land between Sicily and Malta, and Sicily and Cape Bon,"—at all events, that Africa, Malta, and Italy were then united.

extension of both islands than is to be inferred from those soundings. Indeed, it would appear from the data represented on Captain Spratt's map, that an upheaval of the sea-bottom between the south-east extremity of Sicily and the Maltese group, of less than 100 fathoms, would connect the two. Now, as the inclination of the Maltese strata is from north-east to east-north-east, that would about agree with the shallow soundings just mentioned.

Shells peculiar to the Islands.—Again, with respect to the recent and extinct fauna and flora of the Maltese Islands, Sicily and Africa, as exponents of the periods of upheavals, there are some points in which they seem to agree, whilst hitherto researches have failed in establishing the presence of certain extinct and recent forms. In the Maltese islands we find a small recent land snail belonging to the genus *Helix*, which was discovered by Captain Spratt in the neighbourhood of St. Paul's Bay. I have also found it common in winter on the bare limestone cliffs of the west highlands of Gozo; moreover, I met with what appears to me to be the same species, associated with remains of the large and small fossil elephants in the soils and cavern deposits. There is besides one or perhaps two recent closed shells (*Clausilia*) not apparently found in the adjoining continents or Sicily. For the present these represent the only living animals that can be said to be peculiar to the Maltese islands. Turning to the extinct fauna we find the same species of hippopotamus in the caverns of Malta, Sicily, Italy, and Algeria, and the *Elephas antiquus*, so named, has been met with in the alluvial and cavern deposits of Italy, Sicily, etc.; but as regards the remains of the dwarfed proboscidians first discovered by Dr. Agius and Captain Spratt, there is no

well authenticated record yet shown of similar exuviæ having been found elsewhere than in the Maltese islands.[1] These remarkable elephants, in their dimensions, as compared with other living or extinct species, have been pronounced to be respectively about four feet seven inches and three feet in height[2] (*see* Plate).

Valleys of Erosion.—Nearly all the valleys present similar physical appearances, and represent what may be considered valleys of denudation, or progressive erosion. They were possibly, in the first place, mere rents or fissures, subsequently opened out by aqueous and atmospheric agencies. Taking therefore a general view of any of the valleys which run into the Benjemma plateau, the following appearances will be observed:—The upper limestone, in white rugged cliffs, rims the top, for the most part shattered and broken with portions detached, or on the point of parting, from the parent rock,[3] or lying in crumbling masses around its base;

[1] Both as regards the elephants and shells, it would be premature to pronounce them as being peculiar to the islands, for the reason that they have not turned up in adjoining regions. Sicily, although well known, cannot be said to have had its natural history by any means exhausted, and as to its quaternary remains, positively very little has been done, whilst the Maltese islands have been well searched, so that at present, neither as regards the shells in question nor the fossil pigmy elephants, can we safely speculate that one or other will not, on more careful inspection, be found to have also been natives of the adjoining European or African areas, indeed, on the authority of the then President of the Geological Society of London, we have it asserted that a molar of an elephant was discovered in Sicily, and pronounced to belong to the *E. melitensis*, by the late Dr. Falconer. See Anniversary Address at the Opening of the Geological Society of London, by W. Smythe, Esq., vol. xxiii. p. 50.

[2] Description of three extinct species of elephant collected by Captain Spratt in the Islands of Malta, by George Busk, F.R.S.—*Trans. Zool. Soc. Lond.*, vol. vi. p. 227.

[3] Although no very severe earthquakes are recorded to have been experienced in the islands, still rather smart shocks are not of rare occur-

whilst the underlying sand and marl-beds, either in hillocks, or levelled into terraced fields, continue down the slope, covering the sandstone below, which is seen cropping out by the dike sides. It is seldom, however, that any of the valleys in the high lands extend so deep as the lower limestone. The degradation going on is rapid, as the fallen masses of the upper limestone readily disintegrate, and, with the clay and other formations, go to form a rich soil, where excellent crops of cereals are raised. Moreover, the deluging rains of winter wash much of the alluvial deposit into the bottoms of the valleys, and not unfrequently the dikes forming terraces on the slopes give way, when the labour of years is completely destroyed and carried seaward.

Surface Erosion of Limestone.—The usual atmospheric action observed in limestone districts is vividly portrayed on the bleak and exposed rocks of Malta. Wherever either of the limestones are, the surface-beds, for example, along the western parts of Malta and highlands of Gozo, we observe extensive scoopings-out, pot-holes, and honey-combed perforations, with a general surface erosion, so remarkable, that unless we knew the effects of rain and weather on calcareous rocks, it would be easy to conceive that they were the direct result of marine or river action. The pot-holes get often more or less filled with red soil, and thus form natural flower-pots, where the caper flourishes. Now and then, however, a fig-tree's seed takes root, and has in consequence a harder struggle for existence.[1] Notwith-

rence. During the earthquake of February 1861, and on a subsequent occasion, I noticed that several old fissures had been widened, and tottering cliffs on the south coast tumbled down.

[1] The roots of these and like plants, accidentally deposited in such situations, are observed to be thicker and larger than usual, evidently a

standing the atmospheric origin of many of these scoopings on the limestones, there are evidently in other situations, especially in the caverns, to be noticed presently, certain well-marked indications of former sea-levels.

Traces of Ancient Sea-levels.—The valleys of the denuded parts of Malta, such as the Musta gorge and the Wied Hanzier, like others in the denuded district of Malta, run in about a north and north-east direction. At certain points there seem to be evidences of water-lines; but in more than one instance, especially with reference to the last-mentioned valley, such-like markings along the cliffs appear, on close inspection, to be owing to the weather acting on a soft stratum; but on the lower limestone of Migiar Scini, Gozo, lines are perceptible on the sides of the limestone ravine, and what might be called terraced cliffs are seen on the surface of the same rock, above the Malak Cavern; also in the valley of St. Giorgio opening into Marsa Scala, and the walls of its large cavern called El Dalman; and likewise in that of Har Hasan. Now, whether to attribute other and similar indications entirely to the sea during periods of upheaval and depression, or to atmospheric agencies acting on softer portions, or along plains of cleavage, are points on which there may be some difference of opinion. Nowhere on the highest lands can they be traced, unless the surface-scooping, just noticed, is considered diagnostic; but most assuredly the little flats on the sides of the valleys of the Benjemma plateau and Gozo hills cannot be accepted as proofs of marine erosion; indeed, in the absence of other attendants,

consequence of the demand for subsistence, *i.e.*, a sort of natural provision to meet exigencies. Dr. Davy (*op. cit.*) examined many of the roots of these plants, and found them to contain much carbonate of lime, which he fancied was derived from the parent rock.

we are certainly not entitled to cling to them as evidences of the upheaval or depression.

If we suppose that the denudation took place, at least to a great extent, during the upheaval, there is good cause to think that the gorges and valleys were mainly the result of the action of the sea, however much they may have since been opened out by atmospheric degradation, which, although slowly, is surely filing down the superincumbent strata. We might easily imagine a rough sea, of a few fathoms deep, beating over the slope on the north and north-east of Malta, and tearing up the beds and washing them away, whilst the gorges of Siggieui, Musta, etc., were arms and inlets, up which the waves and tides had rolled for lengthened periods. The lower limestone on the southern and upraised sides of the islands being there elevated to its greatest extent, and the inclination of the beds running north easterly, we are able to understand what would be the effects of a sea beating for ages on a land gradually rising in a sloping direction, and thus account for the vast denudation of the eastern portions of Malta, and the eastern portion of the depressed land, to wit, Nasciar Valley. Again, comparing the past with the present, it seems to me apparent, that at the rate now going on it would require an enormous length of time to have brought about the denudation to which these islands have been subjected. Taking the sea on the one hand, the atmosphere and rain on the other, although powerful in their way, seem to me not sufficient to account for the enormous quantities of limestone, marl, and sandstone which have disappeared, especially from the east part of Malta. Let us suppose that the high grounds rose above the surface of the sea with some rapidity, so as not to allow sufficient time for degradation, and that the lower tracts (*i.e.*, east and north-east parts of Malta) appeared more slowly, and were ex-

posed to the action of the sea for a time, the difficulty is easily got over, and the denudation accounted for. On the other hand, are we to take it for granted that all the beds at one time preserved a uniform integrity over the islands, and that they have been denuded in certain localities entirely by the same causes which we find at present engaged in washing them away?

From a consideration of the data in connection with this subject, we are led to the supposition that after the first upheaval and occupation of the land by the large quadrupeds, etc., there was a second depression, at least, almost to the summit of the Benjemma heights, followed by a partial re-elevation which finally ended in the present insular configuration. Doubtless during these long periods of time various disturbing forces were active, and perhaps a forced wave from some volcano, as suggested by Dolomieu, may have swept over the islands,[1] just as in 1831 the submarine volcano of Grahame's Island[2] in their vicinity created the remarkable disturbances narrated by several eye-witnesses.

[1] Dolomieu, who first attempted a description of the Maltese beds (appendix to *Malta par un Voyageur François*, 1791), called the ridge or rather the upraised side of the fault running across Malta from Fommer Rih to Madalena Bays merely "a chain of craggy rocks," and from the strata being elevated to the greatest extent along the south and north sides of the islands, he conceived that they were fragments of a mountain, and that the inclination of the beds being in a north-north-east direction, indicated that there must have been an extensive and sudden submergence towards the south. To meet his views he supposed that a great convulsion must have taken place in the neighbourhood, causing a wave to pass over the islands, and wash off all the soil, which, he said, would account for their bare aspect; and this hypothesis has been lately revived by Captain Spratt, by way of explaining the pell-mell arrangement of the mammalian exuviæ found in the caverns, etc.—*Quart. Jour. Geol. Soc.*, xxiii. 296.

[2] Lyell's *Principles of Geology*, p. 432. I was told by an officer of the Royal Navy, who sailed over the spot where this island appeared, that he took soundings in September 1863, and found fifteen feet of water over the reef, which was composed of white-coloured scoriæ.

Connection of the rocks with the fertility of the Islands.— It is fortunate for the fertility of these islands that they are comprised of soft rocks, which readily disintegrate and retain moisture, otherwise the scanty red or virgin soil would not have been sufficient to rear the crops of vegetables and grain which so well repay the labour of the frugal and industrious islanders. The increase in cultivation during the last two centuries may be conjectured when its present condition is compared with that of three hundred and forty years ago, when the Knights of St. John made their first survey of the islands (A.D. 1525), and found them so barren as to be "unfit to grow corn and other grain, maintaining only a population of 12,000 inhabitants, who lived by exchanging honey, cotton, and the aromatic cumin (*C. cyminum*), for the more substantial necessaries of life." Now matters are very different, grain and cotton being the staple produce, whilst the population has of late been increasing at the rate of 1000 annually.[1] Although advantage is taken of every sheltered nook and ravine, there are large tracts along the Benjemma plateau and towards Gozo, which might be brought under cultivation by the artificial mode just mentioned, especially the rock surfaces near the marl beds on the cliffs; for example, the marl might be conveyed by tramways; thus, by a regular system of rock-digging, much more might be done to improve the barren appearance of both islands, and to introduce arboreal vegetation

[1] The Maltese are a prolific race, and fast spreading over Egypt and North Africa. It would, however, be good for the sanitary conditions of their over-populated cities if more could be induced to emigrate, and when away to stop in their adopted countries; but no sooner does cholera or such like epidemic diseases appear among them, than they flock back in thousands, bearing not only disease to their fellow-countrymen, but doubly insuring their destruction by the excessive crowding on a surface not exceeding 115 square miles.

about the towns and villages, where the heat and glare during midsummer are exceedingly trying.[1]

As a matter of course there must be little vegetable matter in the Maltese soils, from the almost total absence of arboreal vegetation, natural verdure, and under-shrubs. The marl bed along the faces of the higher grounds, and wherever it can be got at easily, is dug out and levelled into terraced fields, or where the steepness renders that impossible, the farmer contents himself by sowing his vetch on the rounded heaps of clay that had been forced from below the sand and upper limestone beds in the slopes; moreover, the sand-bed, wherever the red variety crops out, as in the valleys about Emthaleb and Ghain Toffila, forms (with the above) a soil having all the appearance of the virgin red earth, which it equals in fertility.

Composition of the Alluvial Deposits.—It has been surmised that much of the soil of Malta was imported from

[1] The natural inimical conditions before mentioned seem to have all along impressed the Maltese people with a belief that it is no use attempting to shade their houses with trees, hence the habit of constructing narrow streets and darkening the apartments (the latter, however, chiefly for the purpose of excluding flies in summer). No doubt, to some extent, diseases of the eye, so prevalent among the poorer classes, are excited and maintained through the constant reflection from the bare rocky surfaces. I have often noticed clouds charged with moisture passing over the islands, that doubtless would have dropt their contents had the surface been clad with arboreal vegetation. Now, whatever grievances the present generation of Maltese may have against one of their late Governors, I opine when the remembrance of the past has died with them, there will spring up generations who will not think so unkindly of one during whose rule, trees were extensively planted in the cities; the old and noble halls of the Knights of St. John refitted and decorated in a manner worthy of their present and former occupants; an excellent market, a fine barrack, and a splendid opera-house,—for these and other objects, both useful and decorative, young Malta ought surely to kindly call to remembrance the name of Sir John Gaspard Le Marchant.

Sicily. This is palpably incorrect, although there are records of insignificant imports from the island during the occupation by the Knights of St. John. The alluvial deposits are however very scanty, and composed of a brick-red calcareous earth, containing a large percentage of iron and lime, the latter no doubt derived from the rock formations, which are comstantly crumbling up with the weather, and forming intermediate varieties of soils. The red earth, however, being similar in composition to that of the other islands and lands bordering on the Mediterranean, renders it highly probable that it was the original or virgin soil of the islands; moreover, it is in this formation that many of the quaternary remains have been found. But in various situations, also, for example in various caves and rock fissures, I have met with a light-blue or green tenacious variegated clay underlying this deposit, and more especially in conjunction with exuviæ of hippopotamus and elephants, so as to lead to the belief that it formed also one of the regular formations after the first upheaval, and may have absolutely overlaid the upper limestone, or was a deposit formed by marine or freshwater action. The red earth contains much peroxide of iron, and effervesces readily with acid, as indeed do all the Maltese soils, excepting the green tenacious clay just mentioned, that is, when it is pure, and not mingled with nodules of lime. The red soil, as met with in an undisturbed state in fissures and hollows along the escarps of faults, forms a rich red loam intermixed with angular or partially rounded fragments of the neighbouring rocks, sometimes loose, or cemented into a breccia by calcareous matter derived from the disintegration of the beds. In certain situations, for example on the red soil and its breccia, which covers portions of the Malak downthrow (see Fig. 1, B), also in the enormous accumulations of rounded

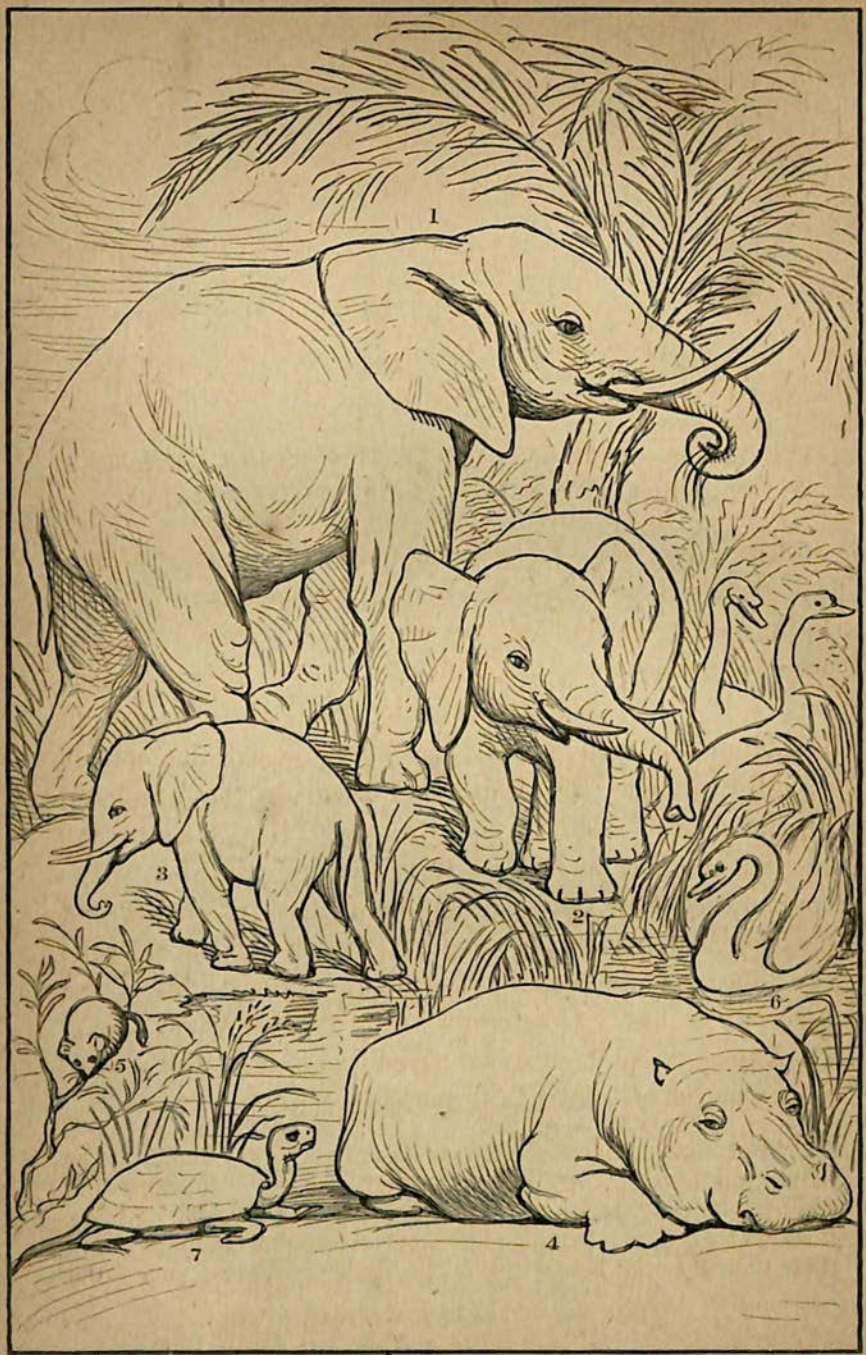
stones and red earth at Fommer Rih, and on the summits and sides of several of the high lands of Gozo, are found fragments of a black limestone with white veins, apparently quite distinct from any variety of the native rocks. Again, many of the pebbles of the calcareous sandstone undergo a metamorphosis when buried in the red soil for a length of time, and in this way: the slow infiltration of lime-water permeating their soft texture, resolves them into a light olive-brown semi-crystalline limestone, the hardening process commencing from without inwards, so that many of the larger masses present an external ring of hardened limestone whilst the central portions remain unaffected. This is well seen among the blocks of sandstone filling the Elephant Gap of Benghisa, at the southern extremity of the harbour of Marsa Scirocco, as will be noticed when I come to describe the contents of this remarkable emporium of organic remains. The surfaces of the rocks also become covered by a calcareous crust, which in fields requires to be removed, as it prevents the absorption of water from the superincumbent soil, and thereby renders the latter unproductive. The light-brown and marly earth is undoubtedly derived from the marl bed, for along the slopes of the Benjemma and Gozo heights it resolves itself entirely into this formation, whilst in the lowland valleys and fields of the denuded districts it is lighter coloured and less clayey, and contains more iron and carbonate of lime from the admixture of the red earth and disintegration of the sandstone and lowermost rock. It is apparent, therefore, that excepting in the immediate vicinity of the marl bed, and in a few hollows and bottoms of valleys, there are no great alluvial accumulation anywhere, and what can be removed owing to the dip of the beds is being gradually washed away. This

is evident at many of the debouchures of the great valleys, and the rapid silting up of the creeks, harbours, etc.; there being no natural barriers to protect the soil, it requires, therefore, considerable trouble and fencing in to prevent the latter from being washed away by the powerful torrents of rain, which fall with tropical violence in autumn and winter. This is accomplished in some degree by digging some distance into the rock, and then filling up the cavities with earth, and the erection of stone walls, which answer the double purpose of a barrier and protection from the winds. These little terraced fields are seen rising one above another, and as their walls entirely hide the verdure from view, a stranger is led to conclude that the country is all but destitute of vegetation, which is really far from being the case. Perhaps few naturally barren slopes present better examples of what human labour and industry can accomplish in the face of overwhelming difficulties than do the terraced fields of the Maltese islands

Saline Springs.—There are few of the larger valleys and gorges that have not a saline spring near the sea-level. At the top of the French Creek in Valetta harbour a large body of brackish water is discharged with some force into the sea from a fissure in the sandstone. Another is observed in the lower limestone of the Bay of Marsa Scala, and two others in St. Julien's and at Pieta, and at the debouchures of similar valleys. The water of several of these springs is used for washing purposes, but none are drinkable. I have supposed that they are mere percolations of sea-water filtered through rock fissures more or less filled with red earth and clay, and diluted with rain-water passing down into them from the surrounding watersheds. I scarcely think

there can be fissures large enough to contain such constant and equable volumes of fresh water, and judging from what appears on examination of the rocks, it may be very questionable if Artesian borings will be successful, as there are no appearances whatever, as far as the rocks are observed, to indicate any subterranean fresh-water streams. All the rain that falls on the great plateau of the Benjemma either runs off its sides or sinks through the fissures of the limestone through the sand to the marl, where it is retained, and oozes out at the points of junction of the latter with the sand. Moreover, the calcareous sandstone and lower limestone pass so imperceptibly into one another, that it is impossible to mark their points of junction; so between them there is no stratum to become water-bearing; besides, the dip of the beds furnishes no proof that the submerged rocks, unless along the lines of faults, incline so as to give the necessary hydrostatic pressure; but as rents and cracks are very common, it is possible that large internal reservoirs may exist in the limestones. Judging, however, from what appears above the sea, this is also improbable.[1] The only hopes of insuring a never-failing supply of spring water seem to me to be centred in the introduction of arboreal verdure (as much as possible), and extensions of the present mode of obtaining the water from the marl on the high lands. Of course the reservoir and rain-tank plans admit also of great expansion.

[1] I understand, after I left Malta in 1866, that experiments were made, on the suggestion of an eminent engineer, with the view of obtaining fresh water, in the supposition that filtration through the rocks of sea-water would remove the muriate of soda. I know not the result, but judging from the mineral structure of the sand and limestone, I shall not be surprised to hear that the trials entirely failed.



Denizens of Ancient Malta.—1. Large fossil Elephant (*Elephas mnaidræ*), p. 223. 2. Pigmy Maltese Elephant (*Elephas melitensis*), p. 216. 3. Smallest Dwarf Elephant (*Elephas falconeri*), p. 223. 4. Fossil Hippopotamus (*H. pentlandi*), p. 212. 5. Great Dormouse (*Myoxus melitensis*), p. 234. 6. Great extinct Swan (*Cygnus falconeri*), p. 237. 7. Large extinct fresh-water Turtle, p. 237.

PART IV.

FIVE YEARS' EXPLORATIONS IN THE BONE CAVES, ROCK FISSURES, AND ALLUVIAL DEPOSITS OF MALTA.

THE discoveries of fossil remains of large quadrupeds in the superficial soils and caverns of Malta have been recorded by one of its earliest historians,[1] who describes teeth and bones of great dimensions, which were, even by the learned of his day, supposed to belong to the Cyclops or ancient inhabitants of Sicily; and what strengthened the opinion was the presence in Malta and Gozo of the wonderful megalithic ruins of Hhagiar Kim, Mnaidra, Malcarte, and the Giant's Tower, and as if to render confusion worse confounded, these, with the finding of teeth of sharks and jawbones and vertebræ, etc., of great whales in the miocene rocks, became jumbled together by the ignorant under the head of "antiquities," referable entirely to the Giant epoch. Thus, in a quaint and studiously didactic style, the above-named author, referring to the subject, goes on—

"But, lastly, what further testimony can we desire of the habitation here of the Cyclops, without the need of borrowing from the ancient scriptures, involved in the obscurity of time, than that given us by the gigantic bones found in Malta, and their hollow burial-places cut in the living rock, and very often

[1] Abela, *Descrittione di Malta*, 1647, p. 145.

of enormous size, as, for example, is that now covered by a small garden in the country, between the Madonna della Gratia and the Tower of Blata el Baidha, and a bone which the owner used as a cross-bar for the door! Another similar tomb was discovered in the vicinity of Zurrico; and we ourselves have seen a molar tooth of the thickness of the finger, and an inch in length, which was extracted from a gigantic head found outside Birchircara, and afterwards given to Paolo Grimaldi, and a similar tooth of the accompanying form and size is in my possession, and several others of these bones we are able to enumerate that have been found from time to time, only mentioning a large rib that for some time lay in Fort St. Angelo, but which was taken away in 1625."

The drawing referred to by the author represents a flat crown, with a long body and three fangs, and is probably a portion of a molar of a fossil elephant. Dolomieu[1] gives a list of the fossils of the islands, enumerating exuviæ of river-horses; among others he mentions certain teeth with a crown surface equal to eight inches, possibly also belonging to an elephant.

During my stay on the islands, and from being constantly engaged in examining their geological features, I formed an intimate acquaintance with the native inhabitants, from many of whom information, either in the shape of specimens or from hearsay evidence, was obtained, of big bones and teeth being turned up from time to time in rock fissures during the construction and digging out of foundations of houses, formation of fields, or in quarrying.[2] The majority of the specimens represented the round upper extremities of the arm-bones of elephants, or plaits of their teeth, and entire or broken molars and long bones of river-horses.

[1] Appendix, *Par un Voyageur François*, 1791.

[2] I was shown by a Maltese priest the head of a humerus and a fragment of a molar of the largest fossil elephant of Malta, which were discovered in a rock fissure when digging the foundation of a house in the village of Zabbar, close to Valetta, about the year 1820.

GANDIA FISSURE.

First authenticated fossil remains of Elephants.—At length, during midsummer 1857, in digging a quarry in the calcareous sandstone close to the village of Micabba, there was observed one of the usual due rents or open fissures running in nearly an east and west direction. It was crammed to the top with red earth and rotting fragments of the parent rock, on the removal of which, some bones of unusually large dimensions attracted the attention of the workmen, who bruited their discovery about the village, until at length Dr. S. Agius, a gentleman residing in the neighbourhood, came to know, when he straightway repaired to the spot and picked up a portion of a molar,[1] with two heads of humeri and fragments of the shafts of the latter, and other long bones, which, with praiseworthy consideration, and instead of retaining, he at once deposited in the Malta University Museum.

Soon after Dr. Agius's discovery, this quarry was filled up with rubbish, and levelled out into a terraced field after the usual manner, in which condition it remained for eight years. In the meantime, another rock fissure was also by accident discovered near the village of Zebbug, from which the remarkable animal remains to be observed presently were collected by Captain Spratt. In 1860, and during the five subsequent years, I never lost an opportunity of utilizing influential friends in attempts to obtain the sanction of the owner to reopen the quarry;[2] at length permission was

[1] See page 221 *et seq.*

[2] The diluvial theory of Buckland has seemingly a few adherents among the well-educated classes of the Maltese. I was told one day by a

obtained, and the Maltese University most laudably undertook the expense, and I was requested to superintend the excavations. Accordingly the quarry was reopened in my presence during the month of June 1865, when, with the assistance of Professor Caruana and Mr. Welch of the 22d Regiment, we managed to examine the entire débris, completing the excavations in a few days, when the animal remains, after a critical examination, were deposited in the College Museum along with the previous portions found by Dr. Agius. This remarkable assemblage of exuviæ I shall now describe.

Gandia Fissure, as I named the gap, from the district in which it occurred, was an irregularly funnel-shaped dilatation of the fissure above mentioned. We found that a good deal had been removed on the occasion of its discovery in 1857, and that the mass of fossiliferous deposit may have been originally fifteen feet in depth and about nine and a half feet in length on the surface, with an average thickness of probably from four to five feet. The rent was traced along the surface of the rock for upwards of 200 feet, and was found to be vertical, with the opposing sides almost in close apposition, excepting at the fossiliferous gap, and here and there

friend that he had heard it stated by a native gentleman of considerable intelligence, that this interference on my part with the relics of the Deluge was quite uncalled for, seeing that they had been placed in their present situations in token of Divine wrath, and therefore should not be disturbed. In the case of the Gandia fissure, I believe the chief cause was a dread that I would appropriate the exuviæ, and take them away from the islands,—a most legitimate reason, which, on being fairly put to me, at once eventuated in the reopening of the quarry, and disposal of its fossil remains in accordance with the strict wishes of the discoverer. I must state, however, that the success of the lengthened diplomatic correspondence on this subject was entirely owing to the kind intervention of Sir Henry Storks, the then highly enlightened Governor of the islands.

along its course, where minor dilatations contained the same deposits, but no exuviæ of animals.

After we had cleared away the loose alluvial soil which covered up the fissure, there appeared adhering to its sides a large firm mass of red earth and stones, about eight feet in height by nine and a half in length, and nearly four feet in thickness. The stones were all composed of the parent rock, and varied in size from a few inches to two or three feet in circumference, and were for the most part rounded and much decayed from having been long in the red soil; others, however, had undergone the change before mentioned,[1] and were metamorphosed into a pale green limestone by the slow absorption of water charged with carbonate of lime. Both stones and earth seemed to have been firmly packed from top to bottom, as if all had been introduced together at the same time. Throughout the mass were strewn abundant remains of elephants' bones, with the teeth entire or broken, together with fragments of bones of very large aquatic birds, and those of the dormouse (*Myoxus melitensis*). None of the animal exuviæ showed traces of having been rolled, and the fragments of rock were for the most part angular, just as if numerous decayed carcases of elephants, large water-birds and rats, scattered about on the surface, had been suddenly swept pell-mell into the gaping rent. The broken and splintered condition of the long bones were remarkable; excepting the feet-bones of the elephants, and long bones of birds, few of the other portions of their extremities were found entire, and seemingly, from their very imperfect state, must have been fractured before their introduction into the gap. But the majority of the elephants' molars were in a perfect state of integrity and

[1] Page 158.

preservation. At all events, it seemed clear that the extensive breaking of the bones was not brought about altogether by the merely dropping into the fissure with the stones and soil, and looked very much as if they had been partially devoured previously by carnivorous animals. The teeth, although preserving their crowns uninjured, displayed instances of rough usage. In the case of a fine last lower molar of an elephant that must have stood about seven feet at the fore-shoulder, we noticed that this tooth had received an injury either before, during, or soon after its deposition in the gap, being broken across, with one half depressed fully one and a half inches below the opposite; moreover, there was a lump of freestone adhering to its outer side, on the centre of the plane of percussion. This molar, showing no marks of pressure behind, and in conjunction with other data, I determined to be a last true molar.[1] On carefully inspecting the exuviæ, I found (along with the remains, discovered before by Dr. Agius) that the Gandia fissure produced entire teeth of at least eleven individual elephants, besides many fragments, which I roughly estimated might altogether have represented sixteen animals. These, compared with numerous other elephantine teeth I had beforehand excavated from the cavern fissure of Mnaidra and elsewhere, disposed me, in 1865,[2] to consider that they represented various stages of growth of a form of elephant, closely allied to *Elephas priscus*, which Dr. Falconer subsequently considered but a form of his *E.*

[1] It was 8·4 inches in length by 2·3 inches in breadth; thus representing a molar double the size of the *largest* true molars of the pigmy elephants.

[2] (1.) History of the Discovery of the Fossil Elephant of Malta.—*Geological Magazine*, No. xvii., November 1865; and (2.) Report to the British Association in 1866. See *Transactions*.

antiquus;[1] but on the subsequent appearance of his posthumous papers by Mr. Busk, and the announcement by the latter,[2] that the cavern remains discovered by Captain Spratt in 1859[3] contained, besides exuviæ of an elephant of ordinary dimensions, and a pigmy species which Dr. Falconer had previously named but not described,[4] there were teeth seemingly not referable to *one* or *other*, and clearly belonging to an elephant not larger than a donkey.

[1] See Falconer's *Memoirs*, vol. ii. pp. 176, 251.

[2] Description of the Remains of three extinct species of Elephants collected by Captain Spratt, C.B., R.N., in the Ossiferous Cavern of Zebbug; and partly from notes of the late H. Falconer, M.D. By George Busk, F.R.S. Read November 22, 1866.

[3] Captain Spratt says the discovery of this cave was made two years subsequent to that of the Malak, which he states was discovered in the summer of 1858, which makes the first revealing of Zebbug cavé in the summer of 1860 perhaps an error. See *Proc. Geol. Soc. Lond.*, vol. xxiii. p. 287.

[4] In a letter received from Dr. Falconer, January 3, 1865, and within a few weeks of his death, in forwarding the money voted by the British Association in aid of explorations then going on under my superintendence, he says,—"Of the pigmy elephant, I have remains derived from at least twenty individuals, and the entire dentition of every stage from the *fœtal age* upwards, not a single link missing. What struck me most, and induced me to defer the detailed account so long, was the absence of large carnivoræ in the collection." [He is alluding all along to the Zebbug remains.—*Author.*] "Many of the bones were fiercely gnawed and splintered, certainly by large carnivora, but the species I never determined, in default of materials. It is to the best of your important investigation that I look most hopefully, *i.e.*, that you may be able to supply the missing forms. Myself and my colleagues (Busk and Spratt) wish you every success in your interesting investigation." The missing link, however, as regards carnivora, it was not my rare good fortune to find, although I worked hard towards that end. Falconer died on the 31st January. Any one engaged in the prosecution of an arduous and interesting study, may well believe that there could scarcely have been more unwelcome news than that which reached me at the very close of my six years' labours in Malta, as I felt Dr. Falconer had been removed at a time when I for one could ill spare him, and there was no one left so eminently qualified to take his place.

Therefore, according to the views of these eminent palæontologists, it came to be a question with me whether or not I was confounding under the head of one, remains of no less than three distinct species of elephants; but seeing that, since my diagnosis was established, there have appeared in Mr. Busk's able brochure, and in the Memoirs of Dr. Falconer, full details as to the specific characters of the elephantine remains examined by them, I shall, therefore, adhere to their determinations in enumerating the contents of the various deposits. Thus, according to Falconer and Busk, the above fissure yielded what may be considered four last milk molars, three first true molars, and three last true molars of pigmy species, including the fragment originally discovered by Dr. Agius;[1] whereas five molars were referable to an elephant of larger dimensions but scarcely as big as an ordinary-sized African or Asiatic elephant.

The other determinable elephantine bones included several fragments of vertebræ, which, as far as comparisons went, were comparable with the molars, and seemed to correspond with large and small animals. The feet-bones were very numerous and perfect, the majority agreeing with owners of the larger-sized molars. Two jaws of the great *Myoxus* were determined, besides birds' bones referable to the great swan, *Cygnus Falconeri* of Parker. This magnificent water-bird, now also extinct, was shown, by exuviæ collected by Captain Spratt and myself, to have been fully one-third larger than the common species; as Mr. Parker, who examined the two collections, afterwards truly remarked,[2] "It must have been a noble creature, and its extinction is to be deplored as much as that of the dinornis and the dodo."

[1] See page 221.

[2] *Trans. Zool. Soc. Lond.*, vol. vi. p. 87.

Such were the data supplied by Gandia fissure. I shall now refer to another important discovery lately made in its immediate vicinity.

SHANTIIN FISSURE.

As late as January of the present year, another cavity, similar both in the nature of its animal contents and alluvial deposits, was discovered in one of the numerous quarries between the villages of Micabba and Lucca. The Shantiin fissure, as it has been named by Dr. Caruana, who has kindly furnished me with the following clear and concise description of its contents, is a rent in the calcareous sandstone like that at Gandia, and runs in a north-east and south-west direction, through a quarry at the entrance to the village of Micabba. This rock rent is ordinarily about three to five inches wide, and if prolonged would most distinctly intersect the Gandia fissure; indeed, such possibly is the case. The ossiferous dilatations of the two rents are not half a mile apart, and so much alike in every respect, that the description of Gandia will almost suffice for Shantiin. When the latter was discovered by the quarrymen, a large detached block of sandstone, six feet in height, almost covered the mouth of the dilatation, forming a natural cliff facing northwards. The outline of the cavity was oblong, about three feet broad and ten feet long, and six feet in depth, with its sides smooth. It was firmly packed with the usual red soil and fragments of limestone and nodules; the latter when broken displayed numerous crystals of carbonate of lime. Interspersed throughout this deposit in pell-mell confusion were discovered upwards of fourteen molars and two tusks of elephants, besides numer-

ous portions of bones, including the articulating extremities of a femur and several radii and ulnæ, together with fragments of ribs and vertebræ; all of which, excepting the last, have been determined by Dr. Caruana as belonging to one or more species of elephants. Several molars were in an excellent state of preservation, and complete in all their details. A portion of a tusk, one foot nine inches in length, furnished a maximum girth of no less than *seventeen* inches, which, as will be shown in the sequel, is two inches greater than the one discovered by me in Mnaidra gap. Dr. Caruana believes that the dental materials he has collected from this fissure represent four milk-molars, including one deciduous or milk tusk, one permanent tusk, and ten true molars of the fossil elephants to be described in the sequel. Besides the above, there were numerous fragments of birds' bones of large size, but no shells or other exuviæ, save two or three small teeth of species of sharks, which he forwarded to me with a fragment of a germ molar of one or other of the fossil elephants. The former are referable to the genera *Lamna* and *Oxyrhina* mentioned at page 140, and most probably were derived from the parent rock, and had been washed into the fissure along with the proboscidian and other remains.

DISCOVERY OF THE ZEBBUG CAVE.

If from the above-named situations we follow an air-line for about two miles in a north-west direction, there will be reached a rather steep ravine,[1] which takes its origin at the western limit of the denuded district,

[1] These gorges are evidently valleys of erosion, and were in the first place rents (as is shown by the well-marked fault behind Siggieui in the gorge), subsequently opened out through aqueous and atmospheric agencies.

beyond the village of Siggieui, and joining another (running nearly parallel with it) at about a mile below Casal Zebbug, they form a main gorge, with steep sides, that eventually debouches on the fine open valley called the Marsa, which is nearly level with the grand harbour of Valetta, on which it opens. Down these ancient gullies, from the southern slopes of Malta, there drains every season a good deal of the rain which falls on the watersheds, and sometimes, during freshets, the usually dried-up torrent channels become suddenly flooded, when what was only a few hours before a streamlet, or a stagnant pool in a hollow, becomes a roaring river, carrying destruction along its course by tearing up the dikes along its sides, and washing large quantities of stones into the productive fields of the Marsa, which, as regards fertility and extent, might be called the garden of the Maltese islands. On the north side of the ravine above noticed, and at the aforestated distance from Gandia and Shantiin fissures, there was discovered in 1859 a cave or rock fissure,[1] containing abundant remains of elephants, birds, and other animal

[1] It is important to establish whether or not this was a true cavern, in the strict sense of the term, or only a rock fissure more or less filled up with stones, clay, and organic remains. I observe Captain Spratt, who names it the Zebbug Cave, applies (*Proc. Geol. Soc.*, vol. xxiii. p. 288) the term "*fissure-like cavern*" to it. Now, as it occurs in a sandstone rock, it was not likely to be a completely shut-in tunnel, 75 feet long, without any roof-opening, or means by which the organic remains, as in the Micabba fissures (we shall presently see also in Mnaidra gap, etc.), could have been washed thereinto. At the same time, although it may not appear so, it is often extremely difficult to determine this point, unless the cavity is cleared out entirely; but judging, however, from repeated inspections of the locality, I must state that I came almost to the certain conclusion that Zebbug cave was a rock fissure similar to the above, but still likely to have been the resort of carnivorous animals, such as the jackal or hyæna, which prefer open-air fissures and hollows as mid-day retreats to even a closed-in cave.

exuviæ, described in the memoirs published by Captain Spratt, Dr. Falconer, Mr. Busk, and Mr. Parker.[1] This cavern or rock fissure (as the case may be) runs in a north-west direction from the ravine, extending through the calcareous sandstone for at least 75 feet, until it narrows to a mere rent at its distal extremity. Captain Spratt says it was "filled to the top with clay," and divided into two branches, the smaller ending in a *cul-de-sac;* that it was 5½ feet in height, with a breadth of about 2½, gradually contracting to a few inches only. He moreover states that the bones and fragments were generally found lying upon the natural floor of the cavern. As a matter of course in a free-stone rock there would be no stalactitic or stalagmitic deposits, all the organic remains being preserved in a marly earth, composed of clay intimately associated with the débris of the parent calcareous rock.[2] Thus, perhaps, Zebbug cave may have been either like Gandia fissure, *i.e.*, an open rent, into which the bones, mutilated, either before or subsequently, were washed, or the roof may have been covered over by débris from the first, when the tunnel became filled up to the top from soil brought inwards, which, however, in the absence of calcareous drippings, and seeing that angular fragments of the native rock were mingled with the soil, appears to me the least likely of the

[1] *Proc. Geol. Soc. Lond.*, vol. xxiii. p. 287, *op. cit.* Captain Spratt forwarded to Dr. Falconer elephantine exuviæ from this locality, amounting to upwards of twenty-two individual elephants. See Falconer, *op. cit.* etc.

[2] I carefully examined the gorges in the immediate neighbourhood of Zebbug, and throughout their entire course, and beyond accumulations of alluvial deposits along their sides above and below Zebbug, showing an exact resemblance to the débris from this cave, there were no natural cavities in the sandstone, which, however, as usual, showed extensive rents and fissures, mostly filled with alluvial deposits similar to those of the Zebbug cave.

two surmises. At all events, the importance of ascertaining the truth as regards its roof is exceedingly important with reference to what I have already stated, and the other caves and rock fissures to be described.[1]

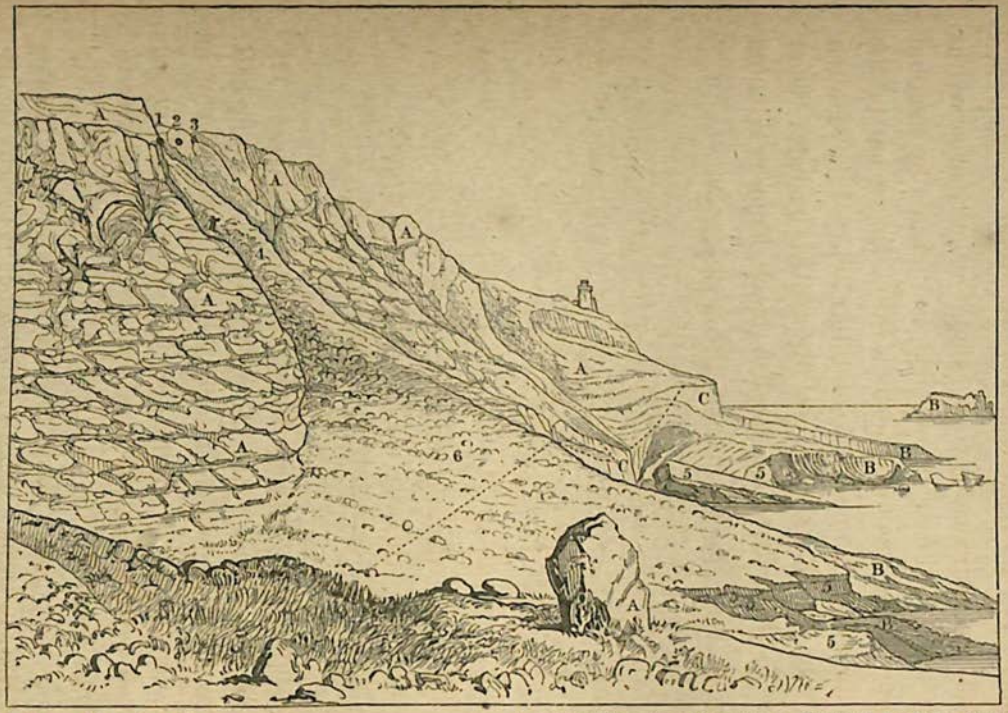
DISCOVERY OF THE MIDDLE CAVE.

Soon after my arrival in Malta I set to work, exploring along ravines and likely places for fossiliferous cavities and rock fissures. At length, after months spent in various quarters of the islands, a red calcareous incrustation on the face of a cliff indicated (Fig. 2, 2) the opening of a tunnel running inwards (*i.e.*, northwards) into the semi-crystalline limestone, and opening on a terrace cliff within a few yards of the Malak cave (Fig. 2, 1) which had been discovered some three years before, and was then well known for the large quantities of the remains of hippopotamus, etc., furnished by its débris. This cave is, as the crow flies, about two miles to the south-west of the Micabba fissures, and bears directly south about three miles from Zebbug cave.

Entirely from its proximity to the river-horses' cavern, and not from any token or trace of organic remains, I determined to break through the pent-up entrance and its hardened surface composed of red soil and stalagmite, which were so

[1] On the 7th of February 1866, a few days after Dr. Falconer's unexpected death, and in consequence of numerous representations made to me by the son of the owner of the property on which this interesting discovery was made, to the effect "that if I would open the cave I should be sure to get very many more bones similar to what Captain Spratt had found in the limited space occupied by the circumference of the tank only,"—accordingly I wrote to Dr. Falconer and Captain Spratt on the subject, and as it appeared that the young man was under a mistake as to the amount excavated by Captain Spratt, I abandoned the undertaking. See Spratt, *Proc. Geol. Soc.*, vol. xxiii. p. 289, where he asserts that he cleared out and examined *all* the débris.

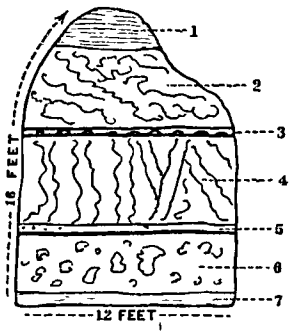
FIG. 2.—Portion of the South Coast of Malta, showing the various Ossiferous Cavities above and below the Malak Fault.



A. Lower Limestone. } Miocene.
B. Upper Limestone. }
Line of Fault - - - - Escarps of ditto, C.
1. *Position of Malak Cave* (*Hippopotamus, Myoxus, Elephas, etc.*)
2. *Middle Cave* (*Myoxus Birds*).
3. *Mnaidra Gap* (*Elephants, Rodents, Reptiles, Birds, etc.*)
4. *Débris from Cave* 1.
5. *Breccia on B* (*Elephants*).
6. *Modern Alluvium Covering*, 5.
Islet of Filfla, Upper Limestone.

firm and tough that our pick-axes had to be replaced by stone hatchets and blasting. It was evident, however, that we were on the right track, and had got into a cave of large dimensions. On its floor—see Fig. 3 (7)—at the entrance was found the white calcareous cement usually observed in the open caves of the neighbourhood, and formed by roof and side drippings; it was overlaid by a thin black seam of the consistence of coffee-grounds, and like what I have often observed on the floors of caves frequented by bats. Over this was (6) three feet of a reddish black loam, very much

FIG. 3.– Perpendicular section of the Middle Cave.



hardened here and there by stalagmitic infiltrations. On the top of this was a seam (5) of yellow earth, from half an inch to three inches in thickness; next (4) a bed of a brick-red clay, averaging from three to four feet in thickness, interspersed with shelves, erect pillars, and hardened masses of dripping, overlaid by a shelf of stalactite (3); over which there was about three feet of stalagmitic red earth (2), when the constant stalactitic drippings (1) hermetically sealed up the opening. Such was the appearance of the section, both at the entrance and at the distance of a few yards inwards, only that all the deposits steadily dipped down-

wards into the interior. There were no stones or any evidences of aqueous agencies of importance having been at work in filling up the cavity; its materials and their stratigraphical distribution showed a gradual process of accumulation, with periods of prolonged tranquillity, when the dripping process was only going on. Nor were there any appearances of roof-rents, although there were many lateral ones of small size. I have now to indicate the organic remains and the particular positions where they turned up. In the stalagmitic shelf (3) and red loam (4), I found several teeth and bones of the gigantic dormice, besides fragments of bones of *Anseres*, and smaller water and perhaps land birds, with a large assortment of the existent land-shells which now abundantly strew the hollows and surface rocks around. In (6) and in its lower part, resting on the black seam of the floor, were discovered two teeth of the great-toothed miocene shark, each with their serrated margins very much worn, as if by friction, besides a jaw and leg-bones of a mouse, not distinguishable from the common meadow-vole, together with fragments of birds' bones and those of fishes, together with exuviæ of frogs of ordinary size.

This cave, therefore, showed that the dormice found in Gandia fissure and Zebbug cave, and, as we shall presently observe, also in two other situations, were no very remote occupants of the area; at all events they lived up to a very late period in the history of this cavern, at a time, too, when the land-shells were absolutely identical with those now existing on the islands. The birds' bones were fragmentary, and seemed to have been gnawed, but I recognised several heads of thigh-bones belonging to the largest fossil swan and smaller birds. The presence, moreover, of fragments of fish-bones, and two much-worn molars of the great toothed

shark,[1] together with the black seam immediately above them, might almost indicate a human occupation of the cavity at a period anterior to the extinction of the gigantic dormouse and swan; but these were the only tokens, and by far too meagre to admit as proofs, of man's contemporanity with them.

DISCOVERY OF MNAIDRA GAP.[2]

FINDING that the Middle Cave was not producing anything like the amount or variety of organic remains I had expected, and what with the expense of blasting and digging through the tough and unyielding stalagmite, I determined to withdraw my men, and commenced (to use a mining phrase) prospecting on the cliff of lower limestone immediately above,[3] where a hardened red stalagmitic earth indicated either the roof of a fissure or mouth of a cavern. Accordingly (but with some forebodings of a failure), I set to work with my soldier-servant, James Critchley, breaking ground on the 15th November 1863. On the third day small fragments of the rodents' remains and morsel of the enamel of an elephant's molar settled the point, and, cost what it might, I resolved to dig out this gap; so sent for my two native diggers, or, as I used afterwards to call them, my elephant-hunters, Carmelo and Luegi.[4] They were willing,

[1] Captain Spratt found numerous sharks' teeth in the clay of Zebbug cave.—Falconer's *Pal. Mem.*, vol. ii. p. 305.

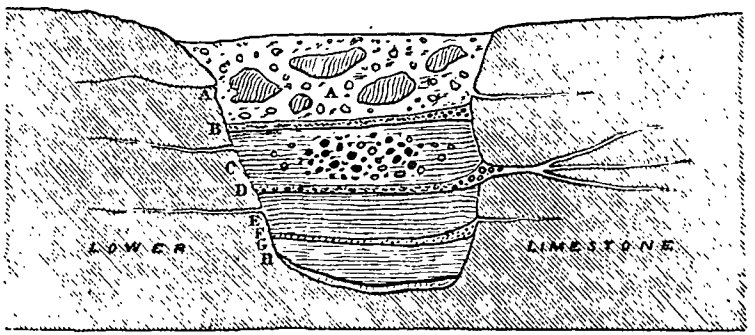
[2] So called after the ancient megalithic ruin close by; it is the Arabic for sheep-fold, and was used for that purpose by the Maltese.

[3] See Fig. 1, F. and Fig. 2, 3. It is represented in Fig. 1 with a roof, which was not the case.

[4] These two men are excellent types of the Maltese rustic: the cummer band round the waist, and wallet or sack of striped native cloth (the latter used for carrying food or other articles), are both remnants of the old costume. The mildness of their climate does not necessitate shoes

wiry fellows, worth their weight in gold to me, and from being long accustomed to the work, knew exactly how to

FIG. 4.[1]



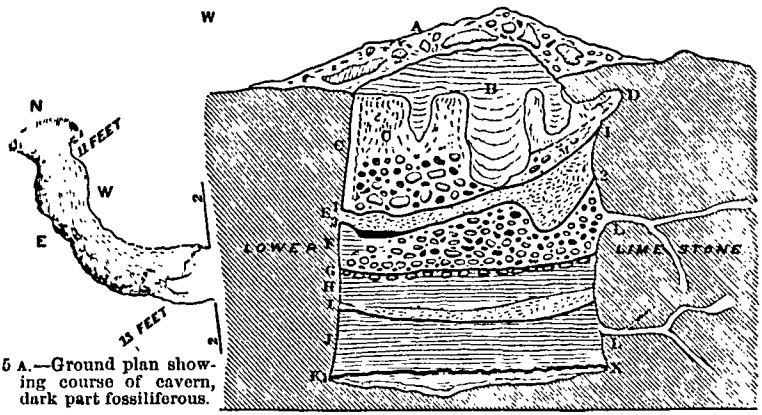
handle the often fragile specimens and remove the débris, so that I could trust them to collect for me when I was pre-

or stockings at any season, whilst they rarely don a coat, unless on Sundays and Saints'-days, when it is then either carried across the arm or suspended from the shoulder in hussar fashion. The simple, abstemious lives and unsophisticated manners of the rural inhabitants are inimical to the din, bustle, and excitement of their crowded capital, which they seldom visit; on the other hand, I knew native gentlemen who had never been five miles beyond the walls of Valetta, and there are many of the villagers of Gozo who have never crossed the Straits of Frioul. On my departure from the islands, these two faithful henchmen came to bid me farewell, when it was with great difficulty I could induce them to sit for their *carte-de-visite*, inasmuch as, no sooner had the photographer placed them in position and commenced adjusting the focus, than it suddenly entered their heads that he meant to shoot at them either with gunpowder (or what they dread as much, the "evil eye"); at all events, before he had withdrawn his head from below the apron they had bolted into the street, and were only induced to return and undergo the operation on the consideration that James Critchley should stand behind them as a pledge that no bodily harm was intended.

[1] A, white calcareous drift with portions of parent rock; B, shelf of stalactite; C, red clay and rounded stones; D, shelf of stalactite and rounded stones on its floor; E, red loam; F, band of yellow loam; G, reddish black loam; H, white calcareous dripping with black seam on the top. The dark markings indicate organic remains which were not found in E, F, G, and H.

vented superintending the explorations, which, however, was not often. For three years we worked together during the the winter months, *i.e.*, from October up to the middle of May, when the blazing heats of summer drove us away from the open-air excavations.

FIG. 5.[1]



5 A.—Ground plan showing course of cavern, dark part fossiliferous.

Referring to the plans showing perpendicular and ground views of this gap, it will be observed that Fig. 4 represents perpendicular sections of the deposits at the entrance on the face of the cliff, and about twelve feet immediately above the middle cave; whilst Fig. 5 is a section at its termination in the *cul-de-sac* at the northern extremity on the little ground plan, Fig. 5 A. The cavity was therefore a simple gap or hollow depression, covered over here and there by loose portions of the parent rock or stalagmitic incrustations, with large pillars

[1] A, white drift; B, stalactite in pillars; C, red soil and water-worn stones; E, yellow sand depending from D, with black seams 1 and 2 above and below; F, ossiferous deposit like C; G, stalagmitic earth; H, red loam; I, band of yellow loam; J, red and black loam; K, stalagmite with black seam; L, rents. The dark shading on ground plan shows the course of the fossiliferous stratum; H, I, J, and K were barren of organic remains.

of stalactite in places. Its greatest length was nearly 100 feet, the breadth varying from 15 to 40 feet, its greatest depth not exceeding 18 feet. It ended, as I have said, abruptly at its northern extremity in a smooth and perpendicular face, which, with the side walls, had all the appearance of a regular water-worn cave, and were arched on the north and eastern sides particularly.

The superficial white calcareous drift on the top A, Figs. 4 and 5, attained a depth of nine feet in places, and contained angular fragments of the parent limestone. Throughout this deposit, chiefly, however, near its inner limits, and even to within a foot of the surface, were strewn indiscriminately fragments of bones and broken or entire molars of the large and pigmy elephants, along with recent land-shells, and the bones and teeth of great dormice.[1]

Below this superficial deposit we came on a shelf of stalagmite, which at the entrance was only a few inches in thickness (see Fig. 4, B), but at the farther extremity (Fig. 5, B) presented large dependent pillars of stalactite.[2] In, but chiefly below, them, the objects of my researches lay in the greatest numbers. This mine of fossil treasures extended from the entrance (ground plan, Fig. 5 A) throughout the entire length, increasing towards the *cul-de-sac*, where they attained their maximum as to numbers and perfection of the specimens.

[1] The exuviæ found here were not generally so well preserved as in the clay of the lower deposits. Many of the elephant molars, however, becoming incrusted with a stalagmitic covering, preserved remarkable freshness, whilst the snails seemed under the same conditions as if they had been buried only for a few months.

[2] These, and the finding of large masses of the rock among the overlying drift, disposed me to think that the cavity had at one time been either wholly or partially covered over—certainly not, however, altogether when the animal remains were being conveyed thereinto.

For the first six months we laboured diligently in pushing inwards along the fossiliferous band, and with various success. At last, I was informed by the late Dr. Falconer that the British Association for the Advancement of Science[1] had voted money towards assisting me in the prosecution of these researches. I therefore redoubled my exertions in Mnaidra gap, and set to work to examine similar deposits, with which a previous acquaintance of the rock formations of the islands had made me familiar.

Proceeding inwards through the red and blue clay (Figs. 4 and 5, c), intermixed with rounded and angular stones and fragments of the two lowermost rocks, we came almost daily on elephant and other remains, such as molars, tusks, bones, etc., complete or in fragments, and crowded and huddled together with those of the rodents, swans, etc.; sometimes all jammed between or lying under stones, or cemented together by the calcareous infiltrations. In one spot, not six feet square, and twelve feet from the surface, and about the middle of the gap, there lay about, in great disorder, no less than twelve molars and six tusks of elephants of various dimensions. One noble specimen of the latter (somewhat over-distended by stalagmitic infiltrations between its layers, nevertheless as to dimensions might have been no discredit to a small-sized African or Asiatic elephant), was the subject of my most earnest solicitations.[2] It rested crossways among large sandstone blocks (Fig. 5, c), which had been hustled

[1] I must not omit to mention the names of Dr. Trower, Bishop of Gibraltar, Mrs. Trower, Colonels Laffan and Montague, R.E., and Mr. Welch of the 22d Regiment, to whom I feel deeply indebted for the substantial aid they extended towards these and other scientific researches undertaken by me in various parts of the islands. The British Association, at the suggestion of Dr. Falconer, Mr. Busk, and Captain Spratt, liberally voted £60 in aid of the explorations in Mnaidra gap.

[2] It is now in the Museum of the Malta University.

down the gap, and were now lying about in every possible state of disorder, either upon or along with magnificently preserved molar teeth and smaller tusks, so that in removing the débris we found it required studied care to prevent injury to the one in attempts to remove the other. The largest tusk, which was not entire, measured four feet two inches in length, and had a maximum circumference of fifteen inches. Indeed, to all appearance, whole carcases had been hurled into the hollow. Bones of the feet, and other portions of the extremities and trunk, lay in apposition, and in many cases entire jaws and skulls were found with the teeth *in situ*, testifying that the majority had been introduced in the flesh, whilst sun-cracks and weather-marks characterized others, and showed they had been bleaching on the surface before being deposited in the gap. Along with these I found remains of the skeleton of a fresh-water turtle of large size,[1] and very many birds' skulls,[2] and bones which will be referred to in due order. The ossiferous deposits were deepest about the middle of the gap, and thinned out towards its mouth, on the cliff overlooking the terrace just mentioned. In the upper stratum (Fig. 5, c), and within five feet of the surface, I was startled one winter forenoon by the workmen exclaiming, "Come, master, here; we have found plenty of *antiqua!*" and surely, before the day's work was over, we extracted three tusks (one almost entire), and no less than nine perfect teeth of elephants (two of which equalled in dimensions those of a rather small-sized Asiatic or African animal); also abundance of bones of the rodents, and numerous

[1] Described in *Quar. Jour. Geol. Soc.*, vol. xxii. p. 594.

[2] Several of these skulls were subsequently identified by Mr. Parker as belonging to the *Cygnus Falconeri*, but others seemed to belong to smaller species (*op. cit.*)

recent shells.[1] Among the vast accumulations of land-molluscs in certain situations, it was evident, although introduced in part with the other organic remains and débris, that many had subsequently crawled into the crevices and hollows. I obtained two specimens of the recent *Helix Spratti*, before referred to at page 149. In a little crevice in the eastern wall (see Fig. 5, M), not three feet either way, among enormous quantities of fossil land-shells, lay the two detached lower jaw-bones of possibly the smallest of the two pigmy elephants, and under them portions of the spinal column, with ribs *in situ*. The black soil around the remains was literally a stalagmitic bone-earth, being made up

[1] I don't think the intense excitement I had previously been worked into when hunting ibex, bears, and the like, on the craggy steeps of the Himalayas, was greater than the delightful sensations experienced when we found ourselves fairly in the midst of the animal remains of this wonderful graveyard. Every molar or fragment of bone likely to be of use in determining the character of its owner was always a fresh trophy, and these on certain days were so numerous that we found difficulty in clearing one of its matrix without inflicting injury on another. Here would be lying the last true molar of a large elephant among jaws and bones of the great rodents, with perhaps two or three molars of the pigmy species either immediately above it, or all, side by side. Thus my Journal records, Dec. 4th, 1865 :—"One milk and two true molars of a small elephant; one magnificent penultimate true molar of a larger species in the masses of stalactite (Fig. 5, B), with evidently its fellow of the opposite side close by, but broken by the workmen during extraction; whole carcass of the dormice, along with beautiful specimens of the common snails (*Helix aspersa et candidissima*, etc.), were all dispersed pell-mell among angular blocks of freestone and variegated red and blue clay; the last mostly in nodules." Dec. 8th.—"In the white drift at the east side (Fig. 5, A), and within a few feet of the surface, we found to-day no less than nine perfect true molars, and three tusks, all seemingly belonging to a large elephant." Dec. 15th.—This was a lucky day. "Among blocks of sandstone and clay we came on what appeared to be entire carcases of small elephants, jammed between and below the masses of rock near the bottom of the fossiliferous stratum; elephants' feet-bones *in situ*, the bones of the head mostly decayed, excepting the molars, but the fragments of the former testified to what had been once entire crania." "Got

of splinters and minute fragments of bones of large mammals, rodents, and birds, several of which showed distinct indications of having been fiercely gnawed by animals of large size, there being indentations of teeth and much splintering of the hollow bones and ribs. A few skulls of the gigantic swan were extracted from the indurated matrix. In fact, this nook or corner, overlapped by a shelf of limestone, might have been the lair of a fox or hyæna, and seemed, in conjunction with the successive and intermittent periods of deposition, to show that the organic remains were introduced at different epochs. Indeed, it may have been that the carcases were washed into the hollows, and the carnivorous animals came there to dig them up, feed upon them, or bring in more bones. The fossiliferous deposits rested on a brick-red loam (see Figs. 4 and 5, E and H), apparently devoid of organic remains, and, in common with the exuviæ of the floor of the Middle cave, seem to have been deposited at the same time, and by similar agencies; but whether Mnaidra had been then

to-day masses of broken tusks; one has a circumference of nine inches; six fine perfect specimens of milk molars, along with others; true molars of adults, all mingled and huddled together along with the largest teeth, besides fragments of tusks and innumerable exuviæ of rodents and birds." Jan. 9th.—"A seemingly perfect skull of an elephant (*containing what would stand as the penultimate true molar of E. melitensis*), but it broke to fragments on being removed from the débris. Several heads and portions of shafts of various bones of elephants were discovered, evidently entire on introduction, as a humerus and two femurs of large and small elephants could be traced from their proximal to their distal extremities. One humerus was eighteen and a half inches in length, with no epiphysis, which would indicate that the owner was not an adult, or, in other words, represented the adolescent stage of life; but it is seemingly uncertain when elephants get their epiphyses consolidated. The fragments of pubic bones, and finding of vertebræ in their natural order of succession, and in a linear direction, show clearly that there must have been several of the elephants introduced in the flesh. Perhaps the truth was, this was a torrent-heap, where the carnivoræ came to dig and also carry their food to eat up at their leisure in its hollows and sheltered corners."

entirely covered over, such was evidently not the case when the exuviæ were conveyed into it. Moreover, the sloping downward from the upper part of the gap of all the deposits, indicated that they had been conveyed from the plateau above downwards into this hollow (see Fig. 1, p. 145), being just the reverse of what obtained in the Middle cave, but resembling Gandia and Shantiin.

Thus, within less than a stone-throw of a cave abounding in remains of hippopotamus, we find a gap filled with stones and soil, containing hundreds of teeth, etc., of elephants, and thousands of remains of great dormice, etc., *but not a trace of river-horses.*

Although many of the elephantine bones, especially those of the feet, showed every appearance of having been introduced in the flesh, there were not a few that testified, by their cracked exterior and surface decay, that they had been lying out on the surface before they were conveyed into the gap. Now, as no watershed divides the Malak from Mnaidra gap, water pouring over the slope would wash its contents easily into one or other, and even down the steeper incline on to the Malak depression (see Fig. 1, B C, and Fig. 2, B), where, we shall see presently, similar elephantine remains were discovered.

The history of the deposition of the contents of the fissure cavern of Mnaidra, read by the light its data produce, appears to me to be as follows :—We perceive three distinct kinds of arrangement of the débris in connection with the fossiliferous deposits,—1*st*, When water passed down its floor, bearing along pebbles and fragments of bones and teeth of proboscidians, rodents, birds, shells, etc.; 2*d*, A rush of water containing blocks of sandstone from the slope above, together with soil, and portions, nay even entire

carcases, of the animals just mentioned, and, finally, the scourings of the rock-surfaces, and whatever organic remains still lagged thereon, up even to the very level of the plateau on which the fissure opened; *3d*, The mode wherewith the organic remains and the stones were piled, indicated that they had been conveyed, at all events for the most part, from the west and north sides[1] of the gap, from the reason that the débris and remains were piled up pell-mell along the concave eastern wall, the most perfect remains being invariably found towards the interior of the gap, as if they had come sooner to a stand-still. On the slope above I discovered several sandstone blocks lying in pot-holes, or what might have been water-worn crevices of the lower limestone. Perhaps they had been deposited there at the same time that the masses of freestone were being carried into the gap.

Thus, Mnaidra gap seemed to me to indicate a period when merely surface soil was carried down its sides, as was observed in the Middle cave, followed by periods of tranquillity, as shown by the shelves of dripping; then came in pebbles with fragments of animal exuviæ; then periods of rest, followed by a great rush of blocks, clay, and organic remains, which were soon covered over, until at last a superficial drift from the now almost denuded watershed, along with whatever animal remains were left, ultimately filled up the cavity. During these turbulent and quiescent periods of its history, there may have been a slow subsidence of the area and a constant occupation of the recesses by foxes and carnivoræ who fed on the bodies, or dragged them into the hollows.

If we simply suppose the carcases were lying rotting on the surface, and were washed downwards into the gap, then I see no difficulty in explaining the phenomena, as Busk

[1] The block over the Shantiin fissure faced northwards.

and Falconer explain the accumulation of the wonderful organic remains of the Gibraltar bone fissures.[1]

In accounting for the abundance of the exuviæ of living and extinct quadrupeds, discovered through the indefatigable researches of Captain Brome in the rock fissures on Windmill Hill and elsewhere on the rock, they remark, "The wild animals above enumerated during a long series of ages lived and died upon the rock. Their bones lay scattered about the surface, and in the vast majority of instances crumbled into dust, and disappeared under the influence of exposure to the sun and other atmospheric agencies, as constantly happens under similar circumstances at the present day. But a certain proportion of them were strewed in hollows, along the lines of natural drainage, when heavy rains fell; the latter, for the time converted into torrents,[2] swept the bones, with mud, shells, and other surface articles, into the fissures that intercepted their course."

THE OSSIFEROUS BRECCIAS OF THE MALAK FAULT.

On the surface of the Malak fault, or downcast fragment of the upper limestone, immediately below the caves and gap (see Figs. 1 and 2), are masses of alluvial deposit and breccia, formed of red earth, angular and rounded portions of the native rock, as well as the calcareous sandstone and lower limestone, besides fragments of the hard black limestone referred to at page 158. This alluvial formation

[1] On the Fossil Contents of the Gneista Cave, Gibraltar, by G. Busk, F.R.S., and the late Dr. Falconer.—*Proc. Geol. Soc. Lond.*, vol. xxi. p. 366.

[2] Just as I observed at the commencement of the description of the elephant cave of Zebbug, as obtaining in its neighbourhood even at the present day.

(Figs. 1 and 2, B and C, and 6) slopes downwards from the base of the cliff and line of the fault to the water's edge, where it forms steep banks (Fig. 2, 5), which are being gradually worn away by the waves. In fact, the deposits in this situation have much the resemblance of a talus, and look as if they were the washings of the slopes above the caves, from whence, indeed, as just surmised, they may have come. Among masses of breccia and red earth on the shore, and impacted firmly between blocks of the parent rock and others of sandstone, I removed the greater portion of a skull containing the last upper molars *in situ* of the pigmy elephant of Falconer. These, and several detached molars discovered subsequently in the same formation, were much chipped and injured from having been evidently rolled along with the stones among which they lay. Fragments of the bones of birds, and two teeth of a ruminant, the latter in no ways differing from those of the goat or sheep, were dug out of the same formation, but at higher levels than I had found elephantine remains, so they may belong to a far more recent period.

It will be observed, therefore, in reference to Figs. 1 and 2, that the deposit containing elephants' exuviæ rests on the upper limestone, which rock, during the period of the deposition of the drift and organic remains, must, at all events, have stood at the level of, or even below the lower limestone, from the circumstance that the bony breccias are made up of fragments of the latter rock in conjunction with portions of the calcareous sandstone and upper limestone. Now, if the land had originally been standing at the level of the upper limestone of the Benjemma plateau, when the elephantine and other remains were buried in its soils, we should not have found the calcareous sandstone and lower

limestone entering, at all events, so intimately into the composition of its alluvial formation; besides, it was especially remarked that all the organic remains I discovered showed distinct traces of having been severely damaged by the numerous angular pebbles among which they were found. So evident was this that I deemed it useless to continue further explorations in the deposit.

One point I appeared to have gained by this discovery, viz., that the land was in all probability sinking when the fossiliferous deposits of Mnaidra (at all events when the breccias of the Malak fault), were formed, and that then the watersheds would be changing, and perhaps river and other water-channels were diverging and carrying destruction along surfaces not formerly subjected to similar inundations, and thus gradually cut off from the continents of Europe and Africa, and becoming restricted to smaller and smaller areas, all the quadrupeds began to perish, the last to succumb being the carnivora. Such conditions running over long periods of time, agree with the evidences of oscillations of level I pointed out when considering the faults and suchlike memorials of upheaval and depression, and, as far as I know, these views seem in no way opposed to the phenomena I have now to describe.

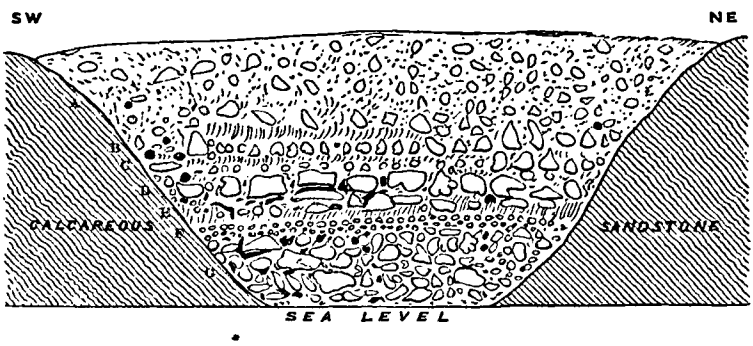
ELEPHANT GAP OF BENGHISA.

One of the most remarkable and suggestive series of explorations in connection with the discovery of these interesting post-pliocene fossil remains, was made by me in a gorge on the south-east extremity of Malta (see map). It is four miles, as the crow flies, from the Micabba fissures, whilst from Mnaidra gap it is five miles distant. Here in the

calcareous sandstone there is a cove or inlet up which the sea penetrates for 700 feet, to the base of a large bank, composed of stratified red soil and water-worn blocks of sandstone (see Fig. 6), the height of which was thirty-two feet from the water level. The sides of the gorge incline at angles of forty-five degrees, embracing between them a surface breadth of 110 feet of alluvial deposit. During heavy southern gales and strong siroccos, the sea dashes furiously up the gully on to the crumbling face of the pit, which is being rapidly worn away.

In November 1864, when examining the loose red soil around the base of this pit, I detected fragments of elephants'

Fig. 6.—Vertical section of Benghisa Gap.



teeth and tusks, which led to future excavations and following results :—

The arrangement of the contents of this gap, named Benghisa (from the watch-tower close by), although differing in some respects, is eminently suggestive with reference to the other deposits just described, and the mode by which their organic remains were conveyed into them. On the bottom are large blocks of the parent rock mixed pell-mell with red soil and silt (G) derived from disintegrated fragments.

On the top of this a layer of gravel and rounded water-worn freestone pebbles (F), then a stratum three feet deep of a rich ferruginous red loam (E) with only a few pebbles and freestone blocks intermixed.[1] On the top of this lies another layer of rounded blocks (D), *far more rounded and water-worn than those at the very bottom, and having deep grooves and hollows scooped out on their surfaces.*[2] Some of the masses are fully fifteen feet in circumference, and when broken up display the metamorphic limestone character explained at page 158, so that many present only an outer layer of hard limestone, whilst the central parts retain the original softness of the freestone,—for the reason, I imagine, that after the stones had been subjected for a time to percolation of lime-water, the latter ceased and then the hardening process resulted, which ultimately prevented its subsequent extension inwards. It was in this layer, which is about twenty-four feet from the top, that I discovered the greatest amount of organic remains. Above it lay another of pebbles and red soil (C), which extended upwards until within six or eight feet of the surface, when the soil changed to the white calcareous drift (A), containing scattered fragments of sandstone which showed faint traces of stratification, and to all appearance was exactly like the superficial drift of Mnaidra gap. This section, therefore, displays several distinct alternations of bands of large water-worn blocks and seams of loam and pebbles, representing periods of turbulence and of comparative

[1] The red soil of this stratum was very compact, splitting into perpendicular joints when dried; there was no appearance of lamination, such as would be the case during a slow deposition of detritus.

[2] None of the materials in this gap furnished more convincing proofs of the action of running water than these deeply grooved stones, and being composed of a light rock, soft and easily attrited, there was no end of the various shapes they assumed.

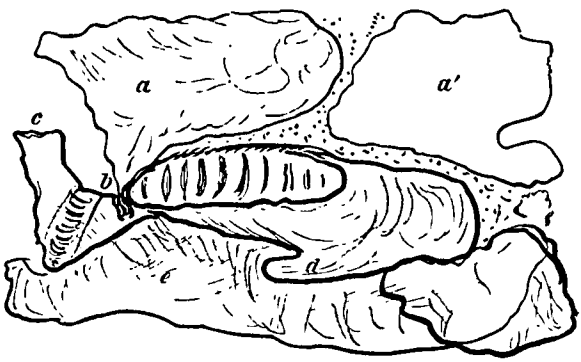
quiescence, such as would result from violent floods or freshets pouring down a gorge. I found the elephantine remains identical in every respect with those already mentioned. Be it observed, however, that no organic remains were found in the white drift (A), which, indeed, was looser in texture and more calcareous, and might in consequence have been not so preservative as the lower beds. Among the large blocks of freestone, either impacted or strewn in a heterogeneous manner, were lying seemingly entire skeletons of elephants, some of the skulls and jaws furnishing good evidence of the rough usage they had sustained by being broken and crushed flat by blocks, which, with the force of impact, had cracked the others on which they impinged.

These conditions were beautifully illustrated in the cases of thigh and entire pelvic bones, which had been smashed to pieces by blocks falling on them. In another situation we came on the entire upper jaws, with their molars lying uppermost, on a flat stone, which with two others formed a sort of triangular cavity, in which the fossil lay closely packed among the red soil; but as testifying to the rough usage to which the elephantine remains had been subjected when being deposited in the gap, especially in layers D and G, was the discovery of a right lower jaw, containing what Dr. Falconer would have considered either the last or penultimate true molar of his *Elephas melitensis*. The accident is illustrated by Fig. 7, *a a'* being the blocks of percussion, the sharp angle of the first having impinged on the jaw just in front of the tooth at *b*, bending it almost at right angles. The condyle was gone, and the opposite ramus had been detached at *c*, a little beyond the chin on the opposite side. The fragile coronoid process and enamel of the crown being uninjured, would seem to show that the jaw could not have been conveyed

along with the blocks for any great distance until it was deposited on the flat mass of stone *c*.

Entire skeletons of the dormice were found between blocks, as if their bodies had sunk into the hollows as they floated past, whilst fragments of large birds, bones, and traces of a huge fresh-water turtle, and several vertebræ and skulls of lizards as large as a chameleon were found, in con-

FIG. 7.



junction with the same land-shells mentioned elsewhere.[1] Several detached bones of the elephants were sun-cracked and honey-combed as if they had been lying exposed on the surface before their deposition in the gap. Indeed, the

[1] All the land-shells I met with in the Maltese caverns and rock fissures were filled either with red earth or dripping,—the former evidently brought about when being conveyed with the débris among which they were found; the others were probably snails that had crawled in, and were enveloped in the drippings going on at the time. The finding of land-shells absolutely identical with species now living in the same localities, requires, especially on cliff sections, that it should be clearly shown they belong to the epoch of the other animal remains, as helices dig into the soil and become enveloped in breccias now forming on the faces of such pits as the above; accordingly, I was especially careful to be certain in every case of the kind.

appearances presented by this remarkable collection of organic remains seem to me to indicate that water at one time flowed down the gap, and was subject to occasional extraordinary deluges, which bore down the large blocks, and whatever exuviæ came within reach; moreover, the conditions were such as we should expect when the land was undergoing a slow subsidence; thus, by diminishing the force of the stream a deposition of detritus would take place, which would raise both its bed and the flood-plain around, and continue so doing as long as the subsidence continued; calms and floods decreasing or increasing the amount accordingly. I could not trace the direction of the gap inland beyond a few yards from the face of the pit, owing to the changes of level which must have resulted since its contents were deposited; besides, the sea has encroached very much on the coast-line in the neighbourhood, and is rapidly dissolving and washing away the soft freestone, which, it will be observed (page 124), is of a very perishable variety.

One point strikes the observer on studying the deposit and nature of the contents of Benghisa gap, viz., that whether by the sea, or by repeated waves of translation—whether by land-floods or freshets during periods of subsidence, the forces must have been of no common order or intensity, whilst the blocks, being composed of the same stratum (a variety of the sandstone in which the gap exists), could not have been conveyed from a long distance, and therefore the state of the denudation of the surrounding area was not very different from what obtains at the present day, else we should have found fragments of the overlying beds among the deposits of the gap—a remark equally applicable to the Zebbug, Mnaidra, and Micabba deposits. Although my explora-

tions in Benghisa gap did not exceed eight feet in a horizontal direction, and were not extended equally over the face of the pit, being mostly confined to the south-west side, where the earth was more firmly packed, and therefore the organic remains in a better state of preservation, I nevertheless exhumed exuviæ representing at least two dozen elephants, besides vast quantities of fragments of bones, teeth, and tusks.[1] Some of the latter seemed almost entire, but were not in a good state of preservation. In computing the specific characters from the entire molars, there are in my collections what I think represents nearly every stage of growth of *Elephas melitensis* (perhaps also *E. Falconeri*), besides true molars referable to the largest species; and here, as was invariably the case in all the other situations, we generally found detached molars of the three elephants lying side by side.

I was always on the outlook for the faintest indications of man in conjunction with these remains. On one occasion, when engaged digging in this gap among the red soil and water-worn blocks with my friend Captain Swann, and we were removing a portion of an elephant's thigh-bone from between the firmly impacted stones, there appeared among the débris a triangular and awl-pointed fragment of the calcareous sandstone, thickly incrusted with stalagmite, which, when removed, displayed a flat even surface, gradually tapering at one end to a curved point,—such a tool as might have been useful to a primitive race in making holes; but as it bore no traces of chipping, and

[1] All the bones met with in the red earth were enveloped in stalagmitic crusts, as if the hardening of the matrix had resulted from the decomposition of the flesh, after the portions of the animals were deposited.

assimilated closely to many other water-worn stones in the gap, I finally rejected it.[1]

ANCIENT GRAVELS AND BRECCIAS.

CONDITIONS similar to what have just been described are common at the debouchures of nearly all the large ravines and valleys of both islands, only that they present a more pell-mell and less stratified appearance. Large accumulations of rounded and water-worn stones

[1] Dr. Davy, in his *Observations on Malta*, vol. i. p. 111, refers to the following discovery in 1836, under conditions apparently similar to what have been just described. He says—

"At the Pietà, close to the city of Valetta, there has been recently discovered a remarkable funnel-shaped cavity in the side of the hill, partially filled up with clay, in which were found embedded a portion of the radius of a ruminant, probably of a goat, accompanied with masses of chalk and water-worn stones, and a hard stone, the form and appearance of which clearly indicated that it had been fashioned by the hand of man. I insert a letter from Mr Frere, which he was pleased to address to me on the subject:—

"'If my report had ended here, it would hardly have been worth while to trouble you with it; but the only organized substance which was discovered is a fragment of bone (Mr. Cliff was of opinion that it was the radius of a ruminating animal; Dr. Buckland thought it might have belonged to a seal). It was found embedded in the dense and tenacious clay. But a more singular discovery was made a day or two after: a piece of hard and very heavy stone, about four inches in length and two and a half in width; it was irregularly fractured at the back and at the edges, but on the other and larger side reduced to what may be called a smooth surface; that is to say smooth, with the exception of the traces of the instrument which had been employed for the purpose of giving it an even surface. These traces are very distinctly observable upon it. This stone, like many others which were found embedded in the same clay, was covered with a black fuliginous varnish, a mark of authenticity, which, if I had had any suspicion of the good faith of the workmen, would have been sufficient to remove it.'"

I visited the locality in 1865, and found it to be a funnel-shaped dilatation in a fissure of the calcareous sandstone, not unlike that of Gandia, with its sides smoothed, excepting several deep vertical furrows

and soil, forming heaps twenty to fifty feet in height, may be observed at the entrances and along the sides of the valleys opening into St. Paul's and Melleha Bays.[1] There is, moreover, an enormous accumulation of rounded stones and red soil on the face of the cliff at the termination of the Grand fault at Fommer Rih Bay and at Madalena Bay on the east coast; indeed occasionally, as before stated, during violent rain-storms in autumn, many of the gorges and valleys

similar to what obtains on the escarps of faults, caused no doubt by interposed fragments of rocks during periods of oscillations of level. The white chalk nodules turned out to be rotting fragments of the parent rock, being plentiful also among the pebbles and blocks of Benghisa gap. The matrix was a clay intermixed with disintegrated freestone. The owner of the property referring me to the late Dr. Davy for further information regarding the whereabouts of the bones and articles discovered, I accordingly wrote the veteran philosopher, who although then an octogenarian, displayed in this case the same indomitable zeal on behalf of science that distinguished his earlier days, and were prominent features to the last in his illustrious brother. Writing in reply, he states, "I have just made repeated inquiries of the relatives of the late Mr. Frere regarding the stone and bones mentioned in my work, but I very much regret to say that they have not been preserved; but Mr. Frere's nephew informs me that he had seen this stone when in Malta. He expresses doubts, from its appearance, that it bore marks of human art, yet adds, 'It is remarkable that this single stone should (if the polished face was natural) have retained its polish amongst the rounded pebbles and boulders in the chasm.'" There are therefore at present no data (whatever the future may bring forth) to establish the presence of man on the area during the epoch of any of the fossil fauna. Perhaps, however, as my friend George Macleay, F.L.S., humorously remarked, when I finally discarded the stone-implement from Benghisa gap, "some future palæontologist may be more fortunate than you have been, and not only establish man's presence there, but also show that he rode the donkey elephants!"

[1] The remarkable accumulations of modern and pre-modern deposits in this situation, described by Captain Spratt, *Proc. Geol. Soc.*, xxii. p. 296, I cannot help believing, will turn out, on close inspection, to be very different from what he supposes. One always appeared to me to be the usual sand dunes now forming at the top of the bays, the other the incrustations and heaps of stones and earth above mentioned. How the first can have any connection as regards true causation, or in mineral or

become flooded to a great extent, and carry down loose portions of the rocks, so that we have only to suppose a more extensive watershed to account for the phenomena presented by Benghisa gap.

I failed, after careful search, to discover any fossil remains in the former situations, perhaps for the reason that the soil is loose, and would not probably preserve them for any length of time. Nevertheless these accumulations may have been formed at the same time and by the same or like agencies with the fossiliferous deposits just described. Besides these ancient heaps of water-worn stones and earth, there may be seen a reddish-white calcareous cement, incrusting the surface of the rocks or the sides of the valleys (for example, on the north-west side of St. Paul's Bay). It contains angular fragments of the parent rock, and the black marble observed on the Malak depression, etc., and is similar in every respect to that in which the elephantine remains were discovered in the following situation.

ST. LEONARDO FISSURE.

On the north-east coast, within a few miles of Valetta, and at present washed by the waves, I discovered in 1864 what

animal components with the others, is to me incredible. With respect to the origin of these deposits, and the débris of the rock fissures having been accumulated through earthquake waves, there is certainly the fact that the Maltese islands are in the centre of the great volcanic area, and during oscillations of level may have been subjected to "waves of translation," which are always the heaviest waves,—the waters first retreating then advancing, and with overwhelming force tearing up the beds, striking deep at first *only*, then afterwards rolling on with a rapid perpendicular decrease of force, which is almost confined to the surface. It would seem to be the first plunge that does the most harm; it would therefore require many waves to explain the alternations of the deposits of Benghisa and Mnaidra gaps.

I have named the fissure of St. Leonardo, after the little tower in the vicinity. Here, in a gap in the calcareous sandstone, filled with calcareous grey drift and angular fragments of the parent rock, I exhumed the last molar teeth and several bones[1] of the pigmy elephant, reposing under similar conditions to those described in the Gandia, Shantiin, Mnaidra, Benghisa, Malak downthrow, and perhaps also Zebbug cave. Thus, individually and collectively, all more or less display the same characteristics as to the arrangement of their deposits and organic remains; moreover, being all in the great Denuded district as matters of course, were likely to be subjected to the same aqueous agencies. I repeat, therefore, I see no violation of laws different from what we believe would obtain during a gradual subsidence of a large tract of land.

THE HIPPOPOTAMUS CAVERN OF MELLEHA.

To the traveller coming from St. Paul's Bay by the road leading to Melleha valley, there is little to connect the presence of such animals as the hippopotamus with the bare

[1] With reference to what I have stated at page 167, in my report to the British Association, referring to this and other explorations, I in 1865 described all the elephantine teeth found by me as belonging to one species, approaching in the *crown pattern* to the so-called *Elephas antiquus*, which is supposed to have been of the ordinary size.

Although Dr. Falconer had then propounded his opinions on Captain Spratt's collections from Zebbug, he did not during his lifetime publish his reasons for establishing distinctions between the smallest and largest teeth, or indeed any other bones met with in the Maltese deposits; consequently, according to the view taken by me, the largest molar of *Elephas melitensis* would have been the first true molar of the large; and, as far as I can see even now, whilst the dimensions of the largest teeth establish beyond question the presence of a fair-sized elephant, I cannot, at least at the present time, find among the extensive exuviæ

verdureless surfaces on which he is gazing. When he has passed through the little village down the slope, it will be noticed that the craggy sides of the ravine are studded with numerous caverns, some of large size, and occupied even now as human habitations, storehouses, or cattle-pens.[1] About thirty years ago, when a road was being formed from the chapel close by to the graveyard on the slope westward, it was found requisite to cut through one of these caverns, on the floor of which, among hardened stones and clay, were found teeth and bones of the hippopotamus, which Captain Spratt collected out of a dike close by in 1862.[2]

I examined this locality in 1863, and was fortunate in picking up several teeth and fragments of bones in masses of a conglomerate composed of rounded and water-worn pebbles derived from the parent rock, bound together by a light blue clay similar in all respects to that found in the cavern in the Malak quarry, as will be shown presently. Several entire specimens of teeth and tusks procured by me on the above occasion, were carefully compared with similar remains from the Malak cavern, and found to differ in no ways, either as to dimensions or outlines, from the so-called *Hippopotamus pentlandi*. I mention this circumstance, as I find it recorded by Captain Spratt[3] that the exuviæ collected by him from the same situation indicated a smaller species than the animal met with in the Malak cavern. Indeed, a

collected by me any of what could be called the milk molars or intermediate teeth of this elephant, unless the true molars of *Elephas melitensis* are so accepted, and that apparently cannot be, for reasons to be stated in the sequel.

[1] The poorer classes in this district continue to occupy several of the natural caverns, which they have enlarged either as dwellings or to shelter their domesticated animals. (*For position of this cave see Map.*)

[2] *Proc. Geol. Soc. Lond.*, vol. xxiii. p. 290.

[3] *Ibid.* p. 291.

fragment of a curved tusk extracted from the blocks of conglomerate (now hardened almost to the consistence of rock), showed a circular measurement equal to the largest specimens of *H. pentlandi.*

I searched in vain throughout the other caverns, and along the under cliffs for miles on each side of this gorge for traces of similar deposits. From all I could observe on the spot, and the descriptions of Captain Spratt, it would appear that this was but a fragment or fag-end of a cave which opened into a ravine near its upper end,—this ravine being in the upper limestone of the depressed portion of the islands, and upon the verge of the southern escarp of the Melleha fault and bay (the other hippopotamus cavern we shall see overlooked a similar downthrow). Thus in two situations, on opposite sides of the island, and ten miles apart, we find river-horse remains embedded in precisely the same description of deposit of undoubtedly aqueous origin, and, in both cases, in gaps or hollows. The Melleha remains, however, having been cleared out, and the outline completely defaced, we can only surmise the nature of the cavity to have been somewhat similar to the Malak cavern, which unfortunately nearly met a similar fate before any one was found to take an interest in preserving its exuviæ.

THE MALAK CAVE.[1]

THE discovery of this remarkable cavern was also made accidentally, and when quarrying a cliff of the lower lime-

[1] The orthography of many of the Maltese names of localities has been subject to much diversity, scarcely two authorities adopting the same mode of spelling. I designated this cavern, in 1861, Maghlak, after the name of the locality and quarry in which it was found, and now, for the sake of euphony, and in accordance with the native mode of pronunciation,

stone on the upraised side of the Malak fault (see Fig. 2, 1), at the height of about 280 feet above the sea-level. I visited the locality about three years after the discovery, when every particle of its contents had been cleared out, and the outline completely destroyed. There was therefore considerable difficulty at first in making out the relation of the various deposits, but after a protracted and careful examination of great portions of the remains on the side of the cliff, and in public and private collections, together with the evidence of the quarrymen, the connection became clear and indisputable. The persons who made the discovery stated to me that when blasting the rock, about twelve feet from the surface they suddenly broke through the roofs of two distinct caverns, one of which contained no organic remains, but only rain-water, whilst the other was thickly covered with incrustations of calcareous drippings; moreover, that the outline of both was hemispherical, the diameter of the fossiliferous grotto being about six feet, its height about four feet, and length probably not exceeding thirty feet. It was for the greater part filled with deposits, and there was a small external aperture which looked towards the sea, and was all but blocked up by incrustations (stalactites). Subsequent admeasurements of masses of the deposit agreed with the surmises of the workmen, and showed the depth of the ossiferous deposits to be about six feet. An Italian who had assisted at the clearing out of the cavern informed me that among the vast aggregation of huge bones and teeth, in conjunction with stones and hardened clay, he recognised an entire skull, with large crooked and

I have here changed the spelling to Malak. This is the Crendi cave of Captain Spratt (*op. cit.*), after the village of that name, which, however, is fully two miles distant. The native name of the cliff in which this cavern was discovered is *Halk-essigiar*.

straight tusks.[1] During my observations I was enabled to trace the fossiliferous deposit for some distance along the terrace cliff, on which the cavern opened.[2] Probably, therefore, the above was also a fragment of what had doubtless been a large cavern, that at one time extended in a southerly direction, but had its outline and the greater portion of the organic remains removed during and subsequent to the changes of level, of which the Malak fault already noticed is the exponent.

Proceeding from the surface downwards, I found the deposits and their organic remains arranged themselves much as follows. None of the latter were observed in the superficial stalactite and stalagmite, which gradually became looser in texture, and passed into a calcareous grey sinter, more or less tinged with iron, and containing nodules and small seams of a dark brown loam. Here abundance of land-shells were found, all absolutely identical with species now living on the islands, together with remains of great extinct dormice, and fragments of the bones of birds, some of large size. As the deposit deepened the exuviæ increased in quantity, more especially the rodents' remains, which became exceedingly plentiful, but were very fragmentary. The greatest thickness of this stalagmitic deposit examined by me measured two feet. At its lower horizon the organic remains suddenly ceased, and a layer of stalagmite several inches thick covered a conglomerate.[3] In fact, the deposits just described were evidently the result of a slow introduc-

[1] No doubt that of an adult hippopotamus.

[2] This terrace is fully sixty-five feet broad.

[3] It was in every respect a conglomerate, in the strict geological sense of the term, which is important to bear in mind, especially with reference to the nature of the débris of this cave and Melleha, as compared with the deposits before described.

tion of soil with drippings from the roof enveloping the animal remains, just as might have been the case had the cave at the time been frequented by predaceous birds that eject the bones of the animals they feed on. The next and lowermost deposit was very different from the above. It consisted of a conglomerate of pebbles of the parent rock, bound firmly together by a light brown or blue clay, like that of Melleha cave; sometimes brick-red, and so hardened as to be nearly as indestructible as the pebbles themselves. The latter varied in size from the size of a pea to stones fully two feet in circumference; all were very much polished and water-worn, showing they had been rolled about. Spreading through this mass, and to all appearance in regular pell-mell confusion, were strewn broken bones and detached teeth of river-horses of all ages, from the molar just cutting the gum, to the old trefoil crowned tooth of the adult. The straight and curved tusks and molars were as a rule in a wonderful state of integrity, and could not have been much rolled about with the stones. During the first two years of my residence in the islands, and on many subsequent occasions, I devoted a considerable portion of my leisure time to the examination of the débris of this cave, and in extracting and measuring molars from the hardened matrix, and in searching among the widely scattered débris on the slope (Fig. 2, 4), for the presence of other animals in conjunction with the amphibian. Moreover, I inspected specimens of the deposits in public[1]

[1] A block of the conglomerate in the museum of the University, Valetta, is about a foot in thickness, and four feet in length. On the surface I counted straight and curved tusks belonging to at least six individual river-horses. There were faint indications of other animals. For example, Dr. Falconer observes (*op. cit.*, vol. ii. p. 306), that in the collections from this cave sent to him by Captain Spratt, there was a small

and private collections, and on a rough calculation estimated that remains of upwards of thirty old and young hippopotami[1] had passed under my observation, irrespective of what were destroyed or lost and taken away by visitors. At length, after having seemingly examined every portion of the contents on the cliff, I was rewarded, to my great delight, by the discovery of an elephant's molar,[2] much worn, and adhering firmly to a limestone pebble, with which it had evidently been rolled. The specimen was too im-

canine or outer incisor of a carnivorous animal of the size of a fox. A somewhat similar specimen was found by me, which Professor Owen afterwards examined, and stated was like the incisor of a seal.

[1] Precisely the same commingling of vast quantities of the remains of individuals of all ages characterize the hippopotamus caves of Sicily, and are evidently dependent on similar causes.—Lyell's *Antiquity of Man*, p. 175; *Anca Bulletin Soc. Geolog. Paris*, t. xvii. p. 684; and *Pal. Mem. Falconer*, vol. ii. pp. 562, 558, and 596.

[2] Few, excepting the student of nature, can rightly estimate the amount of pleasurable excitement that falls to the lot of him who after days or years' devotion to his particular subject of inquiry suddenly, perhaps by a piece of good luck, or as the result of close attention and perseverance in his researches, at length attains the object of his solicitations. I can well picture to myself Mr. Wallace's intense satisfaction on the occasions he so vividly describes in his enchanting volumes on the Malay Archipelago, and although in a homelier field of research, it was to me a "happy find," when, one bright winter day, I was engaged at my old occupation, with hammer, chisel, and pickaxe, on the slope below the cave, there happened to turn up a piece of conglomerate with a fossil in it, which my companion, Mr. C. Wright, perceiving straightway, placed in his satchel for his own collection. Never was I more agreeably surprised than, some time afterwards, when seated in this gentleman's study, and casting my eyes over the self-same nodule, supposed by him to contain nothing unusual, to find it held the greater portion of the tooth of an animal for which I had fagged for years in attempting to confirm its contemporariness in the Malak cave with that of the river-horse. Thus the broken link in the chain of evidence was filled up, and I don't know if my friend was cognisant of the fact, but I do verily believe if he had there and then asked me to stand on my head, I would have at once essayed the undignified position; as it was, I have some recollection of an attempt at an Irish jig.

perfect for specific determination, but from the thickness of the plaits, and the relative size of the tooth, it was clearly a true molar of one or other of the pigmy elephants. No land-shells or rodents' bones were found in the conglomerate; they were especially abundant, however, in the overlying stalagmitic crust, which was literally one mass of bones and teeth of dormice, with fragments of birds' bones.[1]

The deposits of the Malak cave, therefore, very clearly illustrate two epochs in the history of this ancient rock cavity. One, a turbulent age, when the highly polished and water-worn limestone pebbles, blue clay, river-horse, and elephants' remains were deposited pell-mell on the floor. Second, a period of prolonged tranquillity, when there was gradually introduced vast quantities of broken bones, and teeth of dormice, fragments of birds' bones, and entire land-shells, the latter of such species as now frequent the area.[2] Thus the first or turbulent period is absolutely the same as regards the fossils and nature of the deposits in both the Malak and Melleha caves, but the absence of the elephants' exuviæ in the latter, and no seeming trace of any overlying deposit, as far as its very imperfect and deranged

[1] It seemed clear that the majority of the snails and other land-shells had crawled in and died on the spots where we found them, as they had been empty, and were now more or less filled by drippings, mostly stalactite.

[2] I submitted specimens to the critical examination of the late distinguished conchologist, Mr. S. P. Woodward, whose very words were, "Among the helices you sent me is a smooth globular species which I cannot name at present, and I have since received a single example of a small conical and striated species. The others are *Helix aspersa, vermiculata, candidissima, pisana, globosus, aperta, striata, flavida, Bulimus acutus, Clausilia syracusana.*" Of all these, *Helix candidissima* was the most common, and that is about the case now-a-days, although the physical aspect of the islands must have been very different then.

products extend, although notable, must not be considered as certain, seeing that nearly a score of years elapsed between the destruction and removal of the débris, and when Captain Spratt, and afterwards the author, ransacked the rejectments on the dike behind the Chapel of Melleha.

The first periods, therefore, in both caves, represent a clayey bottom,[1] with rounded stones subject to much aqueous disturbance, during an epoch when detached teeth and other disjointed and much fractured fragments of river-horses, and odd portions of elephants' skeletons, were being tossed about among the pebbles, either through the agency of water, or trodden down by carnivorous animals who had dragged them into the dank caverns. Then succeeded a quiescent epoch, when constant dripping from the roof and sides sealed up the pachydermata, and the caves, mayhap, became the home only of the weasel, bat, and owl—the latter disgorging his pellets of rats' bones and hair, night after night, as the great horned owl of Egypt is wont to do in the caves of Sioot (see p. 74); all this time land-snails were crawling in, and being (as at the present day in many of the neighbouring caverns) enveloped in the general dripping and calcareous incrustations.

Similarity betwixt the animals of Ancient Malta and Modern Africa.—The seeming difficulty in connection with the river-horse remains as found in Southern Europe is, how to account for the enormous assemblages of such huge animals in small caverns and contracted spaces. The celebrated caverns of Maccagnone, Olivella, etc., in the basin of the Bay

[1] The blue clay met with on the floors of these caves seems to form the lowermost deposit in all the large caverns. I found it in the floor of the great cave of Har Hassan, as well as in others in various parts of the island.

of Palermo, contained such vast quantities of the fossil bones of hippopotami that ship-loads were removed to make lamp-black. The more one reads of the existing quadrupeds and other animals of Central Africa, the more they seem to assimilate to the ancient denizens of the Maltese area. Sir Samuel Baker tells of turtles of extraordinary size on the Blue Nile;[1] that the river-horse of the Atbara congregates in vast herds in pools of dried-up water-courses, which, like the Blue Nile, become furious rivers in the rains; that it wanders at night to great distances and ascends very steep and rugged declivities; moreover, that their swollen carcases and those of elephants and turtles are borne along to great distances by floods and freshets.[2] Supposing, for unreckoned ages, such animals had lived on our now submerged land unmolested by man, who after all has done most to contract the range and exterminate the living pachyderms of Africa; that in process of time their numbers multiplied, when at length there took place a sinking of the area,—gradually and irregularly, —until portions became fairly insulated and separated from what is now Europe and Africa. Thus the contracting of the range of the feeding-grounds of the land animals decreased the subsistence of herds of river-horses and elephants, at all times given to wander far and wide. The former are partial to muddy pools and rushy banks, whilst both are attracted far inland by good pasturage, and being usually gregarious, it is not at all unlikely that the above inimical conditions would finally eventuate in death by starvation of vast assemblages, and whilst the elephants would perish on the plains or river banks, the hippos would seek their final resting-places along the miry sides of

[1] *Nile Tributaries of Abyssinia*, p. 40. [2] *Ibid.* p. 70.

pools and river caves, the next inundation carrying off their remains, which would be covered over now and then, or washed into hollows and caverns only flooded during such freshets.

The marks of gnawing on certain bones from the Zebbug cavern and Mnaidra gap, whilst tending to establish the presence of carnivora in these cavities, do not in any way presuppose that such was not the general case in all the other situations. Narrow ravines and gullies are the favourite midday resorts of canine and feline quadrupeds, into which they convey portions of bodies of animals to devour at leisure; moreover, where a profusion of carcases exists, such as the jackal do not deign to attack the bone as long as the flesh predominates, and one can fancy thousands upon thousands of hippopotami dying from starvation on some river bank, and the carnivora carrying their mutilated remains into their dens. On the Himalayan mountains I have frequently visited the carcases of bears I had killed on the previous day, and found the flesh entirely removed by jackals and foxes, as well as raptorial birds, but rarely any of the joints of the extremities disarticulated and none of the bones gnawed, and (as in the Maltese caverns and deposits) the feet and spinal bones *in situ*; these I scarcely think are relished by such animals, as I have also noticed in carcases of cattle destroyed by tigers and leopards. I should therefore consider that the absence of traces of carnivorous teeth on fossil bones is no proof that they had not been conveyed into situations by flesh-eating animals. Indeed, as regards Mnaidra and Gandia fissures, it is likely that they were lying about on the slopes of a watershed, and may have been partly washed in by floods, and conveyed also by flesh-eating mammals.

DESCRIPTIONS OF THE ANIMAL REMAINS FOUND IN THE BONE CAVES, ROCK FISSURES, AND ALLUVIAL DEPOSITS OF MALTA.

Summary and general inferences deducible from the modes of deposition of the animal remains.—Before I proceed to a consideration of the chief characters and appearances of the organic remains, it seems necessary to take a final survey of the various deposits just described and attempt to draw a few general conclusions from the data they furnish. We have seen, at all events, that the hippopotami and elephants most probably lived together on the area; also that the dormice, reptiles, birds, and land-shells were contemporary with them; or, in other words, all the animals I discovered in the quaternary formations existed at the same time, and were found under the following conditions (see Fig. 2, page 174):—

1. Malak and Melleha caves held blue clay, rounded *water-worn* pebbles, and stalagmitic drippings in the former; both were nearly 300 feet above the present sea-level.

2. Malak depression is nearly level with the sea; about 200 feet below the level of the Malak and Middle caves, Mnaidra gap, and upper surface of the lower limestone of the upraised side of the fault; its fossiliferous soil is made up of red earth, with angular and rounded fragments of the upper limestone, calcareous sandstone, and lower limestone.

3. Mnaidra gap was in No. v. bed, its contents were formed of blue and red clays, and red soils with fragments of the calcareous sandstone derived from the slope northward, and stood at a higher level than the Malak and Middle caves and the Malak depression between them.

4. Benghisa gap (Fig. 6, p. 190), in No. iv. bed, contained

layers of stones and red soil *stratified*, and was at the sea-level; its stones were all derived from the native rock.

5. Gandia and Shantiin fissures, in No. IV. bed, were inland, and somewhat above the level of all the others; their contents were red soil and crumbling fragments of the parent rock, the same being the contents of St. Leonardo and Zebbug Cave.

Although from their smallness the islands furnish only scant evidences of the complicated and extensive oscillations of level to which the original area had been subjected from first to last, nevertheless the data I have furnished are at the least suggestive, and, in conjunction with the fossiliferous remains, seem to lead to the belief, that in the first place there was an upheaval of a large tract of land in this portion of the Mediterranean at some period towards or after the close of the miocene epoch. In the second place, that during the quaternary period, the whole or at least all excepting perhaps the tops of the Benjemma heights and Gozo hills were again submerged; and thirdly, that a re-elevation of the land took place, ending in the present insular fragments. Perhaps in the first case there was a connection or contemporaneity in the upheaval of the miocene beds of Malta, Sicily, Italy, Candia, Red Sea, Egypt, Arabia, Cerigo, Azores, Algeria, Southern France, and Spain. Thus the islands of the inland sea may represent portions of a land now occupied more or less by water. When this area began to sink is not apparent, but the fact that the same elephant and hyena now living in Africa existed in Sicily, shows that there was a land connection between the two at a very recent epoch. Again, we have seen, page 61, that living species of shells are strewn in vast quantities and at variable depths all over the Sahara, so that its elevation

above the sea must have also been at a very modern period. In fine, the probability is, that when the Sahara was a sea, the Mediterranean was more or less dry land, and when the bottom of the former was being elevated, so the latter commenced to subside; moreover, the evidences appear to show that the movements were at all events irregular and spread over vast periods. Reverting to the data furnished, and a study of the faults and displacements, it must be readily conceded that the oscillations of level to which even the Maltese islands were subjected were uneven in character, *i.e.*, either the subsidences were irregular or the upward movements were unequal; some parts, as the case might be, subsiding or rising at far quicker rates than others; moreover, portions may have been rising when others were sinking. It is impossible therefore to say whether it is or is not the case that their dislocations, denuded strata, and rents, are the result of the last series of changes of level, or only partly referable to them and the previous elevation when the land first rose above the sea.

HIPPOPOTAMI OF MALTA.

Hippopotamus Pentlandi.

THE specific determinations between living and extinct species of European and African hippopotami are by no means clear. Dr. Falconer, who devoted much attention to the study, was of opinion that the large and small forms inhabiting the Nile and South Africa are but varieties of *H. amphibius;* he considered, however, the West African hippopotamus (*H. liberiensis*) differs widely from any other living species.[1] I referred to this subject (p. 49) when considering the species now living on the Nile and my discovery

[1] Note on the existing *H. liberiensis*, *Pal. Mem.*, ii. 404.

in Nubia of a fossil jaw and teeth, which Dr. Falconer showed to be equal in size to the same parts in the great extinct *H. major*. Moreover, another form, met with also in a fossil state in Nubia, named by him *H. annectens*, he considered might, on further investigation, be shown to be identical with the *H. pentlandi* of the Maltese caves. Thus there may be doubts as to the specific distinctions between at least the one I have now to consider and its living congener, which probably frequented the Nile from the Delta southwards, if indeed it be the progenitor of the extinct European species. I visited Sicily and Italy in 1864 expressly for the purpose of comparing the fossils discovered by me in the Maltese superficial deposits with the rich public and private collections of Palermo, Messina, and Florence. The communities between the fossil teeth of one species of river-horses found in both Sicily and Malta, I found (as had been previously determined by Dr. Falconer) to be unexceptionable, and equal to the so-called *Hippopotamus pentlandi*, which represents an animal about as large as the common Nile species. I believe it is not rare now-a-days to meet with old males of the latter much larger than the average, just as Sir S. Baker found occasionally goliath elephants in herds; but I often remarked not only among the vast quantities of teeth either collected by myself, or what passed through my hands in Malta, and also an examination of the large assortment of teeth of *H. pentlandi* in the University Museum of Palermo and Messina, that whilst, relatively, larger and small molars were not uncommon in both islands, I did not discover one last true molar or tusk that would equal the dimensions of the same teeth of the large extinct individual of *H. amphibius* discovered by me in Nubia. This is important, as out of such extensive and

varied materials the preserving of uniform integrity of size is in favour, at all events, of one permanent race having sojourned on the Sicilian and Maltese areas at or about the same epoch.[1] Moreover, the *H. pentlandi* has been discovered in the soils of Candia and Crete. Dr. Falconer entertained also a belief that the Malak cave deposits represented a smaller species than the above, the molars being equal to those of *H. minutus* of Cuvier.[2]

Similar specimens were not rare in my collections from both Malak and Melleha caves, and as all were detached and without fangs, I conceived they might turn out to be only deciduous molars of *H. pentlandi*. The numbers generally of fangless molars collected by me in these two situations, as compared with permanent teeth, were especially noted in the case of the former cave, where the molars of young and adolescent individuals predominated; indeed, in the absence of other portions of the skeleton, they might have indicated that the shelf or terrace cliff on which the cavern opened was at one time the muddy bank of a lake or river, where herds of river-horses were wont to congregate.

CHARACTERS OF THE MALTESE FOSSIL ELEPHANTS.

Mode of dentition in Elephants.—The earliest traces of the true elephants hitherto discovered belong to the miocene or mid-tertiary epoch, but other extinct proboscidian forms represented by the gigantic dinotherium and mastodon may have ranged still further back in time. The latter, although furnished with tusks, differed widely from the true elephants in

[1] Dr. Falconer, however, met with molars in the Palermo deposits, apparently of the large *H. major*.—*Pal. Mem.*, ii. 545.

[2] Ossemens Fossiles, Atlas i. plate xxxii. fig. 6se.—*Fal. Pal. Mem.*, ii. 307.

the form and structure of their teeth. The numerous members[1] comprising the genus *Elephas* (both recent and fossil) present molars formed of a series of more or less vertical sheaths of enamel, filled with ivory. These ridges, plates (collines when unworn), vary in number from the first milk to the last true molar, and differ also in this respect in different species. The enamel plates, when divided transversely, show different outlines in different species. They rest on a base of solid ivory, which is supported on fangs, whilst the interspaces between the ridges are filled up with a hard and durable cement. In all true elephants there appears to be matured no less than six sets of molars, besides two sets of tusks. Each tooth succeeds the other not from below upwards, but from behind forwards; thus as the fag-end of one tooth is about to drop, its successor has come into wear.[2] So gradual is this process of decay and reparation that the elephant may be said to be constantly teething from birth to advanced age. When an elephant's mouth is closed it will be observed that only the front portions of the four molars are in direct apposition; hence they get unevenly worn, so that the front part of the crown is entirely attrited before the hinder portion has come into wear; all this time, of course, the tooth is being sent forward gradually by the one behind it, which, pressing on its posterior aspect, makes

[1] There are only two living out of some twenty recorded species. The existent African elephant is found in a fossil state in Sicily.—*Pal. Mem.*, ii. 552; *Bulletin, Soc. de France*, 2d series, t. xvii. p. 684. There are teeth found in fossil states also in Sicily, China, Japan, and Western Asia, and even North America, barely recognisable from the living Asiatic species.—Falconer, *Proc. Geol. Soc. Lond.*, vol. xxi. p. 323; Author, *idem*, vol. xxiv. p. 497; Anca, *Bullet. Soc. Geol. de France*, xvii. p. 684, pl. xi. fig. 8 and 8a; *Pal. Mem. Falconer*, ii. 250.

[2] Although nominally the elephant has only four molars in wear, it is often the case that a fragment of one tooth with the first half or more of the crown of its successor is in use in each jaw.

an impression which, in well-worn molars, shows that a tooth so marked cannot be the last of the series.[1] From this remarkable process of dentition, and the numbers of molars matured and worn-out during the animal's lifetime, we may well realize the current assertion that it attains to a very great age. The predecessors of the future or permanent tusks are shown in the calf in the shape of the small ivory-tipped teeth (see Pl. I. fig. 1), which are shed early, and are succeeded by the permanent or true tusks.

Such is a cursory view of the dental structure and mode of reproduction in the genus *Elephas*. Now, as the appearance of the molars differs much in different species, and as these are the least perishable of almost any portion of the skeleton, they will, as matters of course, be frequently met with in a fossil state, and in the absence of other bones prove of great value to the comparative anatomist.[2]

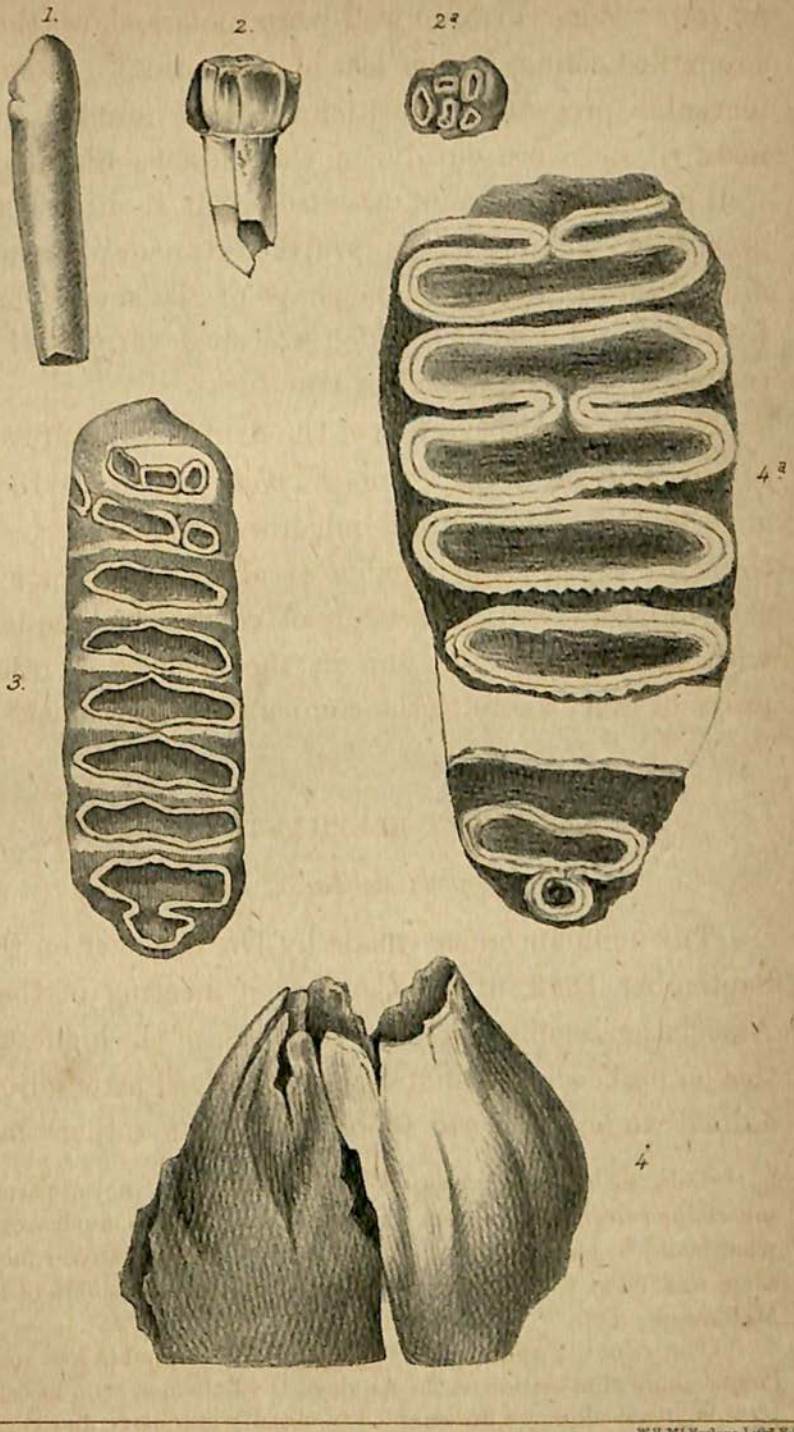
THE PIGMY ELEPHANTS OF MALTA.

Elephas melitensis, Falconer.

THE announcement made by Dr. Falconer on the 6th of September 1862, at the Cambridge meeting of the British Association, coming as it did from one of the highest authorities on proboscidian anatomy, was indeed astounding. The animal we had hitherto found increasing rather than dimi-

[1] This, although doubtless very generally, may not apparently be an invariable rule, as I have seen undoubted milk molars much worn without what could be called a trace of pressure on their posterior face, and the same was noted with reference to penultimate true molars of the largest Maltese elephant.

[2] The odontography of recent and fossil elephants has received the largest share of attention at the hands of Dr. Falconer, who has shown that by this means alone we are enabled to classify extensive and very different materials into genera and species without even the aid of other portions of the skeleton.—*Pal. Mem.*, vol. ii. 76, and *passim*.



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DENTITION OF ELEPHAS MELITENSIS

1. Milk tusk. 2 & 2ª First Molar (nat. size) 3. Third Milk Molar (nat. size)
4. Last true Molar (½ nat. size) 4ª Crown surface of same (natural size)

nishing in size as its history was read backwards, appeared now destined to receive into its genus one, and finally another, both of dwarfed dimensions as compared with any living or extinct elephants. Every one interested in palæontological researches longed to read the descriptions of the remarkable animal; but Dr. Falconer, with studied caution,[1] and for certain reasons I have elsewhere (p. 167) stated, withheld all details of structure, and his untimely death prevented the finishing stroke being put to his labours. This, however, has been remedied as far as possible by the able researches of Mr. Busk.[2]

Dr. Falconer tells us when he began in 1860 to examine the Zebbug collection, he was chary in admitting the convictions which the specimens forced upon him, from a possibility that he might be led into the blunders of other palæontologists in mistaking the youthful molar of a large elephant for the true molars of pigmy species. The materials from which he deduced the presence of a dwarf species of elephant were discovered in Zebbug cave, and comprised a complete series of molars, besides various other bones of the skeleton, which, on comparison with those of other species, afforded data so remarkable, that he considered there could not be a doubt on the subject. Moreover, after Dr. Falconer's death, from among the veritable remains above alluded to, Mr. Busk discovered a second pigmy species.

Besides these two dwarf species there were traces of what appeared to be a third elephant, of about the ordinary

[1] Perhaps few palæontologists of Dr. F.'s vast experience communicated so little to the world; at the same time, as is apparent from his writings, that whatever "he touched he adorned," studied care and caution mark all his labours. Of him it might be truly said—"If he did little, that little was always well done."

[2] *Trans. Zool. Soc. Lond.*, vol. vi.

size, of which, however, the materials were too imperfect for specific determination. I shall now proceed to point out the dental characters of the *Elephas melitensis* as established by Dr. Falconer and completed by Mr. Busk.

The milk or first tusk (Plate I. fig. 1) from the Zebbug collection, is equal in size to one discovered by me in Mnaidra gap. The former did not seem to disagree in dimensions with the corresponding tusk in the African elephant, and although Dr. Falconer[1] seems to consider it belonged to the pigmy, we find Mr. Busk, in the note above quoted, and from further comparisons, stating that, from being equal in size and proportion to that of a fœtal African elephant, he considers the Maltese specimen above mentioned rather belongs to the largest extinct form.[2] Fragments of permanent tusks (none apparently entire), of large and small dimensions, in accordance with the molars and bones, were plentiful.

Molars of Elephas melitensis.—The *first milk molar* (Plate I. fig. 2) being worn on the crown (2^a) shows that it did not belong to an unborn calf. It is composed of three plates or ridges, with a small ridge or talon posteriorly. Of this tooth Mr. Busk truly remarks, that it is the "smallest elephantine molar, fossil or recent, that has hitherto been met with," being not quite *half* the size of the corresponding tooth of the African, and *nearly half* that of the Indian elephant; moreover, in all other members of the genus this tooth has two fangs, whereas there seems to be only one hollow fang in that of *E. melitensis*. At the same time it is well known that sometimes a tooth similar to the latter is developed in the lower jaw of the African

[1] *Pal. Mem.*, ii. 296. See Busk, *op. cit.*, note, p. 284.

[2] Thus it seems doubtful if the first milk tusk of the *E. melitensis* is represented by any specimen in the Zebbug collection.

elephant, and considered by anatomists to be an *unusual or monstrous development.*[1]

The second milk tooth evidently approached closely in dimensions to the *third milk molar* of the series, which is shown (Plate I. fig. 3). The latter is exceedingly common in my collection, and of all the elephantine molars furnished the greatest number of specimens, especially from Mnaidra gap, where alone upwards of forty were found, besides fragments, and no doubt numerous specimens were lost in removing débris. With reference to the *first and second true molars,* the specimens on which Dr. Falconer established their characters were, as usual, in almost every species, perplexing; indeed, the diagnosis of intermediate molars in the genus *Elephas,* or what may be designated the adolescent stage of life, is often extremely difficult; for this reason Dr. Falconer was

[1] There is in my collection four of these so-called first milk molars, viz., three from Mnaidra and one from Benghisa gap. I shall here draw comparisons between them and that referred to, as the subject is of the utmost importance, not only in determining the specific characters, but in relation to the so-called abnormality just stated:—

	No. of Plates.	No. of Talons.	Maximum length of Crown.	Maximum breadth of Crown.	Height of Crown.
			in.	in.	in.
Zebbug specimen, .	3	1	0.40	0·32	0·40
67 Mnaidra, . . .	3	2	0·55	0·3	0·35
103 Do., . . .	3	2	0·6	0·4	0·7
105 Do., . . .	3	1	0·5	0·4	0·4
109 Benghisa, . . .	3	lost.	0·5	0·3	0·3

No. 67 shows faint marks of abrasion on the tips of the first and second plates on the crown, which being narrow in front shows it might be a lower molar. The *single* fang is broken off at the base of the tooth, which is *hollow.* No. 103 was evidently not in use—most probably the calf was *in utero;* it is broad in front and narrow behind, and on that account might have belonged to the upper jaw; here the fang is also *single* and *hollow.* No. 105 was found in a fragment of an upper jaw (?) containing a few plates of the succeeding tooth, which showed no traces of wear; more-

not certain whether to regard the one in question as a first or second true molar.[1] Nevertheless he remarks, "Had this specimen been discovered isolated, little or no hesitation would have been entertained by a palæontologist in referring it to the age of a milk molar of some species of elephant, but when regarded as part of a series in connection with the undoubted milk molars, the whole of which are of such unusually small proportions, and when further compared with the adult molars of the lower jaw, it is manifest that it maintains its place consistently as a true molar."

The last true molar (Plate I. fig. 4 and 4^a) of the pigmy elephant described by Dr. Falconer, is stated by him to be "one of the most characteristic of the specimens."[2]

over the tips of the collines in the former were merely touched by attrition. The dimensions of the advancing plates of the next tooth equalled in admeasurements those of the *third milk molar* of *Elephas melitensis* (Plate I. fig. 3). A mark in front of the former tooth shows where there had evidently been a talon, whilst the posterior talon is large, pyramidal in outline, with a base equal to 0·3 in.; it firmly adheres to the inside and back of the third plate. No. 109 is a well-worn tooth, the talons have evidently been lost, as also a fragment of the enamel on the side of the crown. The fang, as in the last, is *single*, and is entire, and 0·6 in. in length. The crown pattern is similar to that of the Zebbug specimen. Whether all the above represent a rudimentary and irregular tooth, or the first milk molar, seems to me an open question. At all events, as compared with other species, the largest of them indicate a diminutive elephant; perhaps, as Mr. Busk suggests, "that that tooth was normally suppressed and replaced by a functionally developed first milk molar," not apparently represented in the Zebbug collection, unless what Dr. Falconer and himself consider to be the second milk molar can be so considered; but then the harmony of the series would be seriously interfered with.

[1] *Pal. Mem.*, vol. ii. 295, and Pl. xi. 2. It is described here at page 226.

[2] This fine tooth is in a perfect state of preservation, excepting the fracture indicated, which probably occurred during the excavations. I believe it was the discovery of this molar by Signor Buttegieg that led to the collecting of the rest of the exuviæ, and subsequent explorations by Captain Spratt. There is in the Malta University a left upper molar found by me in Gandia fissure, so precisely like the above

Some idea of the extreme smallness of its owner, as compared with the living species, may be obtained from the following:—In the Indian elephant the extreme length of the last upper molar is usually 13 inches, the maximum breadth being 3 inches, whereas the pigmy's tooth is 4 inches in length by 1·55 inches at the greatest width of the crown. Such was the dentition of the *Elephas melitensis* according to the views established by the two eminent palæontologists above mentioned. There were, of course, other points, in

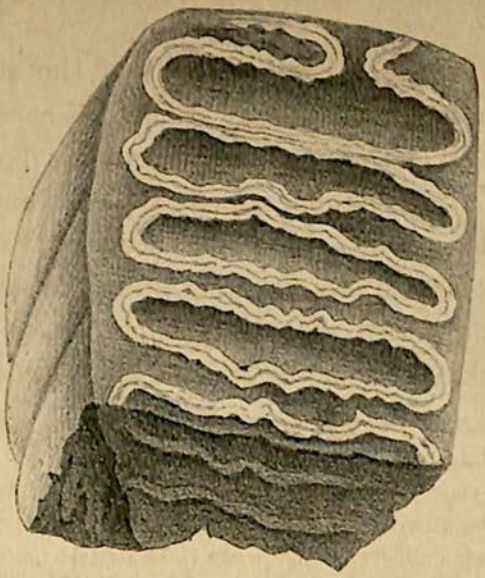
in admeasurements and the markings of its crown, etc., that only the fact of having been found in different situations makes it unlikely that they belong to the same individual. It has likewise not a trace of pressure behind, but, as a rule, upper molars do not always retain good marks, as I have stated, even when well worn, and as these may sometimes be wanting even on members of the milk series, one is apt to confound the true teeth of the pigmy species with one another and with the milk molars of the large elephant; more especially seeing that there is a very pronounced similarity in the shape of the discs of the crown in the *E. melitensis* and the last, to wit, the crimping and angulation of the centre, as seen in the last milk molar, Plate I. fig. 3. The one, Plate II. fig. 1, although a fragment, is undoubtedly portion of a right last upper molar of *Elephas melitensis*. It is from Gandia also, and was the tooth originally discovered by Dr. Agius in 1857, referred to at page 163. This is the molar of which the editor of the *Pal. Mem.*, ii. 299, note 2, states, "careful tracings were transmitted by Captain Spratt to Dr. Falconer, who pronounced it as entirely different from those of the pigmy elephant, but 'allied to, if not identical with, the African elephant;'" moreover, according to the authority just stated, *some person* after Dr. Falconer's death asserted in a Malta paper that the tooth in question had been seen and examined by *somebody*, who had claimed priority to Dr. Falconer in the naming of the *Elephas melitensis*, and the placing it in the subgenus *Loxodon*,—all too on the ground that in my memoir on the Malak cave communicated to the Royal Dublin Society, and read on the 18th of November 1861, I then stated that "in the Malta College Museum is a fragment of a young elephant's molar and the portion of a straight tusk of hippopotamus, I am creditably informed were dug up near Crendi, within a mile of the Malak cave. The fragment to which I have just alluded is much too imperfect to be certain as to the species. It appears, however, from the broad clefts and the plates being very shallow at the sides that it did not belong to the mammoth; the markings on the crown approach *E.*

connection with numerical estimates of the ridges, and the configuration and sculpturing of the discs of the crown, which, taken in accordance with what has been stated and the bones of the skeleton, seemed to place beyond a doubt that they belonged to a distinct species of elephant, differing from any described before, and alike conspicuous by its remarkable small size, averaging from 4 ft. 2 in. to 4 ft. 7 in. at the shoulder, or, as its describer states, "it stood

africanus, which has been met with in the caves near Palermo by Baron Anca and Dr. Falconer."

During the year 1860, when I wrote these *incidental* remarks, I had no knowledge whatever of Dr. Falconer's observations on the Zebbug or any other Maltese collection, and what then struck me in regard to the tooth in question was, its dissimilarity to that of the mammoth which was stated previously to have been discovered in Gozo. As compared with Plate I. fig. 4^a, I think it has a very fair claim to be considered as belonging to the same age of *Elephas melitensis*. In Dr. Agius' specimen, fig. 1, there are 2·5 in. of the anterior portion of the crown uninjured; in that space there are 6½ plates—the breadth of the crown in front is 1·5 in., at the sixth plate 1·7 in.; these admeasurements being to a line identical with an equal portion of Fig. 4^a. Moreover, the form of the discs of wear, discal expansion, relative heights of plates, and the faint crimping, bear so pronounced a similarity to the above and the other referred to from the Gandia fissure, that it may be fairly inferred to be the last upper true molar of *Elephas melitensis*. Moreover, I made a careful examination of the other portions discovered on the occasion alluded to, viz., two heads of humeri, fragments of shafts of a femur, humerus, etc. I may state that the determinable data elicited from the two first were in exact accordance with what Dr. Falconer and Mr. Busk have established as the admeasurement of the same bones in *Elephas melitensis*.

No one therefore will dispute Dr. Falconer's claims to the first naming of *Elephas melitensis*, and I suppose Captain Spratt is the only one who might lay claim to the first discovery of the animal's remains, and well, I am sure, he merits the lion's share of the credit; but seeing that Dr. S. Agius and Signor Buttegieg both deposited specimens in the public museums of Malta previously, and the last-named gentleman's specimen was the one on which Dr. F. founded the dental characters of the adult molar, which, on being duly credited, I trust the mysterious allusion to my memoir above mentioned, by the editor of Dr. Falconer's *Palæontological Memoirs*, will now eventuate in a clear understanding in respect to the would-be purloining of the honour due to both the namer and collectors of the first exuviæ of *Elephas melitensis*.



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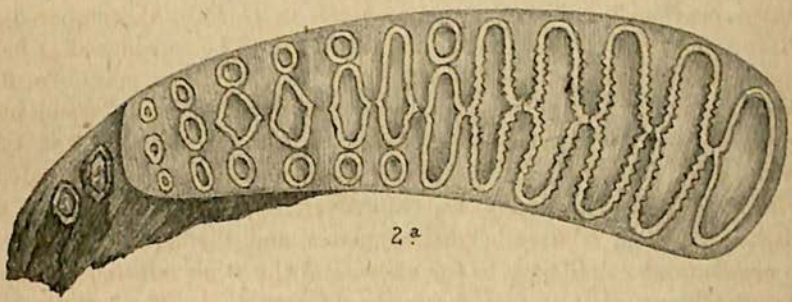

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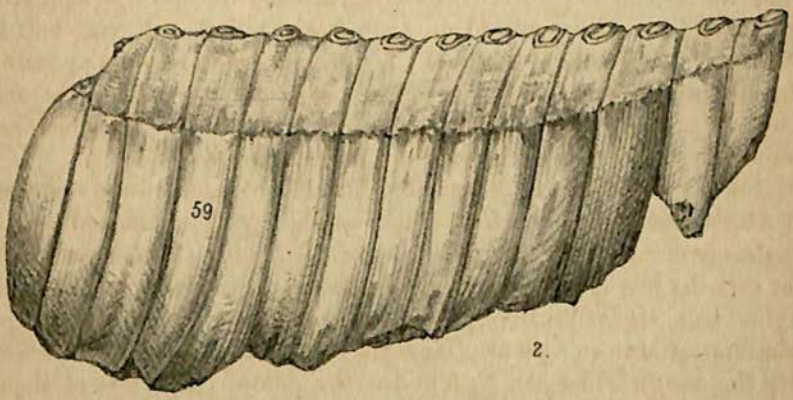

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MOLARS OF FOSSIL ELEPHANTS.

1. Crown surface (nat. size) of Last upper Molar of Elephas Melitensis
2. Profile. 2ª Crown view (½ nat. size) of Nº 59 Last lower Molar of Elephas Mnaidræ.

between a large tapir and the small unicorned rhinoceros of Java."

THE LESSER PIGMY ELEPHANT.

Elephas falconeri, Busk.[1]

As before remarked, the presence of this species in the exuviæ of the Zebbug cave was determined by Mr. Busk after Dr. Falconer's death, and seemingly more or less from fragments of bones, which on comparison with similar portions of the skeleton of *Elephas melitensis* and a foot-bone (astragalus) discovered by me in Mnaidra gap, there appeared such differences both in size and configuration as to warrant the assumption that they represented a still more diminutive proboscidian, the average height of which at the withers could not have exceeded two feet six to three feet.

THE LARGE ELEPHANT OF MALTA.

THE evidences of a large species of elephant furnished by the Zebbug collection rested, as before noticed, on fragments of bones, only which, Mr. Busk remarks, "afford no special characters."[2] It was my good fortune, however, to collect in the various situations here described abundant remains,[3] including entire teeth and other bones, which on

[1] *Trans. Zool. Soc. Lond.*, vi. 251.

[2] *Op. cit.*, p. 235. Perhaps this might prove to be a fourth species. It was for the reason that there should be no difference in opinion between the results of the explorations made by me and Captain Spratt, that I felt anxious to have the Zebbug cavity re-explored in 1865. See p. 173.

[3] I have just received accurately executed drawings of the largest molar teeth lately discovered by Dr. Caruana in Shantiin fissure, and find that no less than six specimens are equal in dimensions to the fifth and last true molars of this elephant. Besides he has furnished me with drawings of what are undoubtedly second and third milk molars of *E. melitensis* from the same locality.

comparison with the same portions of living and extinct species give characters I think must, at all events for the present, be considered specific. I propose to name this new proboscidian *Elephas mnaidræ*, in consideration of the circumstance, that it was in Mnaidra gap that I first met with traces of its existence, and from whence the most perfect specimens of its bony structure were obtained. At all events its exuviæ represent an elephant much larger than either of the two pigmies, which could not have been stunted forms of the larger sort, although, as will be observed presently, there are large and small races of both the Asiatic and African elephants. Nevertheless in every situation where evidences of more than one individual were discovered, we find, at all events, teeth and bones of the *Elephas melitensis* and the large species lying side by side, and, what is also of importance, and should be well borne in mind, viz., there are *several general characters as regards the crown pattern of the molars, common to all the Maltese elephantine fossils.*

Such being the case, and warned by the experiences of others, I shall here (and for the present) avoid a possibility of confounding the bones and teeth of either of the two pigmy elephants with those of the *Elephas mnaidræ*, by describing only remains which, from their relative dimensions, place beyond a doubt that they belong to a proboscidian much larger, at all events, than either of the two just described, and just possibly identical with the above-mentioned fragments of the large species from Zebbug cave described by Mr. Busk.

The fine specimen, No. 59 of my collection (Plate II. fig. 2 and 2^a), is the last true molar right side lower jaw; it shows not a trace of pressure behind, and moreover displays the anterior fang supporting the talon and two first plates, which is invariably the case in the penultimate and last

true molars of all species of elephants. The tooth is much arcuated, and from the seven posterior plates having their tips only invaded, shows that it was just coming into full wear. It will be observed that twelve plates are in use, and that the two last are intact; thus the molar is composed of fourteen plates. This I find is the usual number in both the upper and lower last molars; sometimes another is however occasionally present, but out of ten perfect specimens belonging to this stage of growth all maintain the above, with the exception of the following upper molar, No. 93 of my collection, which, in addition to having in all fifteen plates, has a fragment of the jaw attached posteriorly where not a trace of any advancing tooth is observed, which, with a total absence of any marks of pressure on its posterior aspect, and relative thickness of the enamel and its admeasurements, afford direct proofs that it is the last true molar. The crown pattern is similar in *E. melitensis* and *E. mnaidræ*—*i.e.*, there is more or less a central expansion and angulation of the discs, with crimping generally of the edges of the enamel plates, not extending, however, to the outlying loops of the discs. (See Plates I. and II.)

In making the following comparisons between the fifth and sixth (or penultimate and last) true molars of the Malta pigmy elephant and the large species, I have been particular to note the utmost dimensions of the specimens, so as to show exactly that these two are evidently distinct species, according to the views established by Dr. Falconer and Mr. Busk; moreover, as regards the *E. mnaidræ* I have made especial selection of such specimens as appear to me perfect, or nearly so.

The following tabular view therefore illustrates the comparisons, as far as the dentition is concerned, between what

are supposed to be equivalent stages of growth of *Elephas melitensis* and *Elephas mnaidræ*:—

PENULTIMATE OR FIFTH MOLAR.	No. of ridges, including talons.	Length of crown.	Surface in wear.	No. of discs in wear.	Breadth of crown in front, middle, and behind.	Greatest discal expansions.	Average width of each ridge.	Height of ridges.
		in.	in.		in.	in.	in.	in.
Upper molar of ELEPHAS MELITENSIS (1.), .	11	2·9	2·2	8	1·35 1·3 1·1	·3	·3	9=2·8
Upper molar of E. MNAIDRÆ (2.), (No. 38), .	10	5·3	5·3	10	2·1 2·5 1·2	·4	·539	1= ·5 9=3·6 10=1·4
No *lower* molar of this age is represented by the Zebbug collection; that of *E. Mnaidræ* is well shown in No. 42 A, which is in its place, along with the other ramus and its tooth.								
Lower molar of E. MNAIDRÆ (3.), (No. 42 A), . . .	12	5·8	5·	8	1·5 1·5 .10	·4	·56	1= ·9 5=2·9 8=2·
LAST OR SIXTH MOLAR.								
Upper molar of E. MELITENSIS (4.), . .	10	4·	3·2	9	1·4 1·5 ·8	·4	·35	1= ·7 4=1·9 6=2·3 9=2· 10=1·3
Upper molar of E. MNAIDRÆ (5.), (No. 93), ...	15	7·	5·	10	1·9 2· 1·5	·6	·5	1= ·9 6=3·4 10=4·6 14=2·7 15=2·2
Lower molar of E. MELITENSIS (6.), . .	11	4·4	3·7	10	1·4 1·45 1·1	·4	·6	7=2·05
Lower molar of E. MNAIDRÆ (7.), (No. 59), Plate II. fig. 2, .	14	6·	5·2	12	1·7 1·9 ·8	·6	·51	1= ·7 4=2·2 8=2·7 12=3· Last 2·2

(1.) *Pal. Mem.*, ii. 298; Busk, *Trans. Zool. Soc.*, vi. 295:—"The tooth is complete in every respect, with the exception of the end of the fangs, which are more

or less broken." Mr. Busk however seems inclined to make this a younger tooth, viz., the fourth or first true molar.—*Op. cit.*, note 296.

(2.) This magnificent specimen shows distinct marks of pressure behind; and thus cannot be the last of the series. It is thick plated, faint crimping towards the central expansions; perhaps two to three ridges worn out. Well attrited on the crown, as all the remaining discs are in wear.

(3.) Two talons shown here. Anterior fang supporting three first ridges; remainder with hollow contracting base. Little crimping.

(4.) This is molar (Plate I. fig. 4), just referred to, and the specimen on which Dr. F. established the dimensions of the last upper teeth of *E. melitensis* (*Pal. Mem.*, ii. 292). I give the exact admeasurements from personal inspection of the tooth, which was kindly lent to me by my friend Dr. Cesare Vassallo for description. It is now in the Public Library of Malta. Dr. F. reckons that at least two ridges are worn out, which would add ·7 inches to the length of the crown, and make the original number of ridges fourteen, including two talons. There is crimping of the enamel of the crown, although faint.

(5.) This fine tooth, as just stated, shows not a trace of pressure posteriorly; although ten out of fifteen ridges are invaded by attrition, there is a portion of jaw adhering behind. It has the usual mesial and angular expansion, with crimping of enamel in the same situation, which however does not proceed to the outlying loops. Discs of wear, shallow and open; their sides parallel, and abrupt angulations at the middle of the discs. I believe this elephant had often fifteen ridges in last lower molars, as will be observed from the dimensions of the posterior talons in this case.

(6.) *Pal. Mem.*, ii. 298 (Plate xii. fig. 4, 4A), *Trans. Zool. Soc.*, vi. 294:—"The portion supported on the anterior fang is wanting," for which allowing, as in the upper tooth, ·7 inches, will about equal its original length. This, as Dr. F. states, would give a total of twelve to thirteen ridges to the entire length of the crown. Not a trace of pressure behind. Mr. Busk, *op. cit.*, p. 305 (Plate liii. fig. 11), seems to express a doubt as to the position assigned by Dr. F. to this tooth; thus at p. 305 he says, "Fig. 11, Last (?) lower molar of the left side, M. 3 (p. 294), *E. melitensis* (?)" Now as this is an important objection, I may notice his same plate (fig. 9), that the molar assigned by Dr. F. as the fourth upper just described, is surmised by Mr. Busk to be "the first upper true molar of (M. 1)? of *E. Falconeri* (?)" This must surely be a misprint. The thick plates, advanced stage of attrition, without the usual mark of pressure behind, Dr. F. says, "renders difficult to conceive that it could have been followed by an older tooth driving it forward without leaving the usual mark of pressure;" and assuredly, according to the accepted canons of odontology, this tooth may well claim the position given to it by Dr. Falconer.

(7.) Evidently the semilunar first disc in this tooth occupies the space of one ridge and the anterior talon, which would give a ridge formula of 15, the maximum number of ridges in the lower molars of *E. Mnaidræ*, at least as far as I have seen, out of very many specimens.

As compared with the dimensions of the two last true molars of any other elephants, recent or extinct (the two Maltese dwarf species of course excepted), we find none

unless under-sized individuals of the Asiatic species at all approach the diminished proportions of *Elephas mnaidræ*. I possess detached fragments of molars, etc., exceeding the largest perfect specimens discovered by me, but even they represent admeasurements that would barely give a maximum height of 7 ft. 6 in. to this animal, whereas the average, I apprehend, stood between 6 ft. 10 in. to 7 ft. at the withers. There is a very decided resemblance in the crown pattern of *E. melitensis* and *E. mnaidræ* to so-called forms of *E. antiquus*, but in dimensions, as well as the number of ridges, the three differ widely from each other and from any recent or fossil species yet described. Again, as regards dimensions and other particulars, *E. mnaidræ* is pronouncedly distinct from the African species; still, to all appearances, in the numerical estimate of its ridges, as also in the tendency to central expansion of the discs, it bears, perhaps, also a resemblance or affinity, but clearly both are also distinct species. As to other portions of the skeleton of *E. mnaidræ* I possess various vertebra, and long bones, which, with the fragments of molars above mentioned, would indicate individuals of the maximum size just stated; but the greater majority of the bones are in relative harmony with what are furnished by the molars just described, whilst (and these too form a goodly proportion) the aggregate of my collections seem to establish a complete accordance with the osteologies of *Elephas melitensis* and *Falconeri* of Falconer and Busk. Thus, to all present appearances, we have represented by the remains hitherto collected in the Maltese islands no less than three distinct species of elephants of about the proportions indicated, and represented in the spirited and well-executed drawing, page 161, for which I am indebted to the able pencil

of Mrs. Blackburn, whose admirable representations of animals have obtained for her a high position as a delineator of natural objects.

Characters of the Tusks.—Abundant remains of tusks invariably accompanied bones and teeth of the elephants wherever the appearance indicated that skulls, either entire or in fragments, had been conveyed into the gaps and fissures. From the quantities of ivory found wherever teeth were plentiful, there was cause to surmise that both sexes were provided with defensors. One portion of a jaw (No. 46) containing the last milk molar, almost worn-out, of *Elephas melitensis*, had its tusks entire in their sheath; each tusk measured 4·3 in. in length, with a maximum circumference of 2·2 in., and an average of 1·6 in.; the outline is straight, with a slight outward curvature at the tip, which is blunt-pointed, with a distance between the tips of only 2½ in. There were other bones of the skeleton lying close by, and without their epiphyses; the femur, for example, less its head and neck, is only 4 in. in length! In none of the large or small tusks did the curve present the arc of the mammoth, but, like the African, proceeded gently forwards and outwards with straight tips, which were either thick and rounded or acuminated. One skull of *Elephas melitensis* containing last true molars had a tusk also in place, the tip only of the latter being lost. This specimen showed also a curved outline, with a girth at the incisive sheath of one foot and length of 40 inches along the convexity. The largest have been described in connection with the explorations in Shantiin fissure and Mnaidra gap. The tusks, however, as criteria of the size of the owner, are at best fallacious; Sir Samuel Baker remarks, "They vary considerably, and

there appears to be no rule to determine a reason for their size and quality."[1]

Mechanical conditions of the molar crowns in connection with the food of elephants. In consequence of the shallow hollows between the enamel ridges, and the usually flat and nearly uniformly smooth surface of the last true molars from the Zebbug cave, Dr. Falconer conceived that the food of the Malta dwarf elephant was more herbaceous than woody, but I think had he examined more specimens of the molars of the dwarf species, or seen those of *Elephas mnaidræ*, he would have somewhat modified this opinion. There appears to me decided crimping or festooning of their ridges at about the middle of the discs, which, although not to compare with that of the Asiatic species, or the form designated *E. armeniacus*,[2] is still more declared than that of the African species approximating nearest to *E. antiquus*. In Dr. Falconer's learned and elaborate essay[3] he describes the relative degrees of crimping of the enamel ridges in recent and extinct species, with reference to the alimentary characters.

Looking on the grinding surfaces of the extinct and living species as masticating apparatus, the rough millstone surface of the Asiatic elephant seems well adapted for the chewing of tough vegetable fibre, and accordingly the Ceylon and Indian elephants feed extensively on tough herbage, whilst the open disc and unfluted borders of the enamel of the discs of the African elephant might indicate that the latter fed on less tough articles of food; moreover,

[1] *Nile Tribut. of Abyssinia*, p. 533.
[2] *Pal. Mem.*, ii. 247.
[3] *Nat. History Review* for January 1863.

it is asserted, on the great experience of Sir S. Baker, that the African elephant lives mostly on the leaves of trees, to obtain which it is in the habit of uprooting mimosas of large dimensions by means of its tusks;[1] and as many of the acacias are flat-headed, the richer portion of the foliage being confined to the topmost branches, it can be readily understood that powerful levers would be needed to overthrow the larger trees: accordingly, the tusk of the African elephant is larger than that of the Asiatic. It would seem therefore, by comparing the grinding surfaces of the molars, and noting the development or otherwise of the tusks, that important inferences might be drawn in connection with the physical aspects of the countries frequented by the now extinct species; but whether the tusks are to be considered in the light of crowbars and digging apparatus, or merely as defensive weapons, or both, there is certainly something strange in the Asiatic elephant frequenting Ceylon being, as a general rule, destitute of tusks, whilst the denizens of the mainland more generally possess them; unless it be that the latter use them for the same purpose as the African species. In the case of the mammoth, as the tusks curved in many specimens to the extent of fully three-quarters of a circle, they were therefore useless for the purposes ascribed to the above. Now although its molar presents an enormous number of thin plates, there is the absence of crimping of the enamel, showing that although a good triturating surface, still not so well fashioned as that of the Indian species for tearing tough substances. We may further suppose that the hooked extremities of its tusks were used for pulling down and retaining branches of lofty coniferous and other trees, whilst the trunk was

[1] *Albert Nyanza*, vol. i. 275.

stripping them of their verdure. Thus perhaps the presence or absence of tusks in species and in individuals inhabiting certain districts, may be owing to causes in connection with the physical aspect of the countries. Dr. Livingstone found the tusks of the African elephant increasing in size as he approached the equator, and the same was noticed with the horns of several species of antelopes; but the average height of a full-grown bull elephant on the banks of the Zambesi was from 9 ft. 9 in. to 9 ft. 10 in. at the withers, and generally smaller than those further south, where, as for example on the river Zouga, he found them attaining a height of upwards of 12 ft.[1] "The largest Ceylon elephant seldom exceeds 9 ft., and the ordinary herds do not average more than 8 ft."[2] Sir S. Baker, however, estimates the average height at the first figure, and gives the bull African elephant at 10 ft. 6 in. I am aware of individual Asiatic elephants, both wild and domesticated, that stood 11 and 11½ ft. in height. Such, however, are very unusual dimensions for this species. These variations are important data, to be always taken into consideration in estimating the specific characters of extinct species, inasmuch as they warn the palæontologist to be careful in drawing too hasty conclusions from the scattered and often imperfect remains that not unusually fall to his notice.

Fossil Elephants of Sicily.—The fossil remains of elephants discovered in various parts of Sicily, but more especially by Baron Anca in the rock caverns of Palermo, represent no less than three distinct forms. He established the presence

[1] *Travels in South Africa*, p. 562.
[2] Tennent's *Ceylon*, vol. iv. p. 291.

of the African elephant, besides exuviæ which Dr. Falconer and others considered identical with the *Elephas antiquus* and the form named *Elephas armeniacus*, which approaches closely to the existing Indian species.[1] I examined Anca's collections in August 1864, and was struck with the resemblance, not only of the crown pattern, but in one or two instances with the dimensions of certain molars discovered by him only a few months previously in the Palermo caves, and those of individuals collected by me in Mnaidra and Benghisa gaps. However, as the determinations of the dwarf elephants of Malta were not published, I am bound to admit that I may have here again fallen into the error of believing what I then supposed to be milk or intermediate molars of *E. mnaidræ*, or a closely allied species of its supposed dimensions, would, on a more critical comparison, be shown to belong to *Elephas antiquus*, or perhaps with less probability to the last of the series of *Elephas melitensis*. The greatest difficulty in assimilating the teeth of any of the Maltese elephants with recent or extinct species, is the relatively very much smaller dimensions of what, to all intents and purposes, must be considered the sixth or last molar of the series.[2]

[1] Anca, *Bull. Soc. Geol. de France*, t. xvii. p. 68, Pl. xi. fig. 8; *Falconer's Mem.*, ii. 249, 250, 465. Associated with the above were undoubted remains of the strand hyena, now repelled to Southern Africa, besides two species of hippopotamus, one, as before remarked, identical with the *H. pentlandi* of the Maltese deposits. Dr. Falconer examined the Palermo collections in 1859, before the Zebbug remains came under his notice. The so-called tooth of *Elephas melitensis*, referred to at note 1, page 150, from Sicily, does not appear to have been commented on by Dr. Falconer, as I can find no notice of it in any of his published papers.

[2] Taking the very heterogeneous dental materials assembled by the late Dr. Falconer (*op. cit.*, vol. ii. p. 176, etc.), under the head of *Elephas antiquus*, and the confusion, still obscure, between certain varieties of molar crowns of this elephant and allied forms, it must, I am afraid, be acknow-

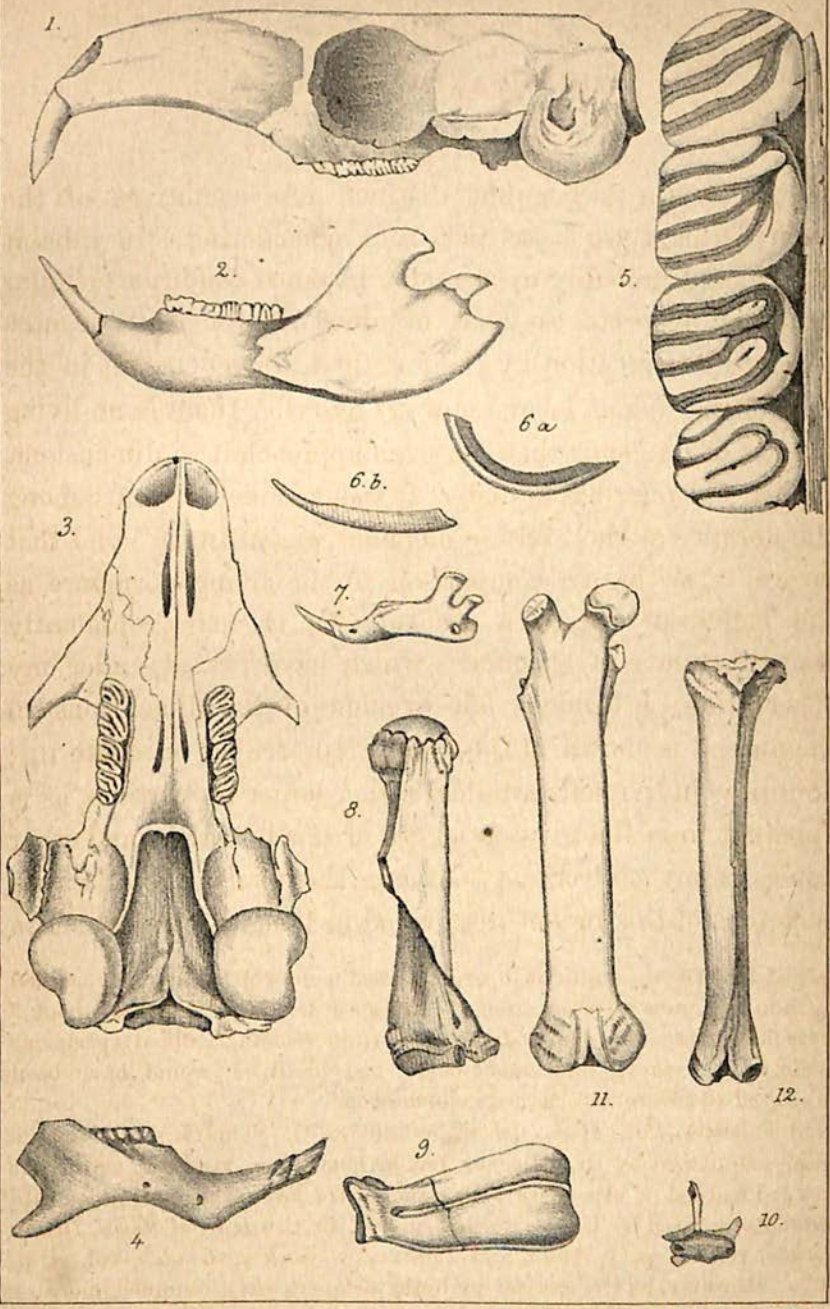
THE GIGANTIC DORMOUSE.

Myoxus melitensis[1] (Plate II.)

ALTHOUGH larger but distinct representatives of the pachydermata we have just been considering still inhabit Africa, and probably exist under physical conditions similar in many respects to what obtained on the Maltese area during its occupation by their extinct congeners, yet in the case of the rodent I have now to describe there is no living species of its genus that can even approach it in dimensions. As Dr. Falconer has stated, "it was as much a giant among the dormice as the Maltese elephant was a dwarf," and that it was "as big in comparison to the living dormouse as the bandicoot rat to a mouse." Of (I may confidently say) thousands of specimens which have passed under my observation, I think a fair average of the dimensions of the animal is shown in the figures represented on Plate III.; doubtless individuals attained rather larger proportions, as is apparent from the greater length of several thighs and other bones in my collections. Among the many almost entire skeletons of this rodent discovered in Benghisa and Mnaidra

ledged that the descriptions of the so-called molars of *E. antiquus* recorded by him and now printed from "entries in Dr. Falconer's note-book," were but notes and observations on certain seemingly allied specimens made from time to time, and which, had he lived, would have been subjected to severe and critical comparisons.

[1] Falconer, *Pal. Mem.*, vol. ii. 300, 305, 307. This is doubtless the species so named by Dr. Falconer, but he has left no record to show that it was identical or otherwise with either of the two forms of dormice subsequently figured by Dr. Carte and myself in the *Journal Royal Dublin Society*, vol. iii. p. 1, 1863, and *Trans. Zool. Society, London*, vol. vi. p. 307. However, as the exuviæ in both instances were obtained more or less from the same locality, and in similar deposits, there is a strong probability that the rodent Dr. F. refers to is the one here described.



W.H.M.c Farlane, Lith.r Edin.r

FOSSIL DORMICE.

1.2.3 Skull of Myoxus Melitensis (nat. size). 4. Lower jaw of Myoxus Cartei.
5. Molars of Myoxus Melitensis et Cartei (much enlarged). 6a & b. Upper & lower incisor.
7. Lower jaw of young. 8. Humerus. 9. Scapula. 10. Articulating surface. 11. Femur.
12. Tibia. (nat. sizes.)

gaps were the bones of a hind foot in place, showing a length from heel to toe equal to $1\frac{7}{10}$ inches. "As compared with other living and extinct species, the fossil dormice of Malta only differed in their gigantic proportions. The first and last molars are the smallest, whilst the middle two are equal and about as long as they are broad (Fig. 3. 5). The crowns present the usual elevated ridges characteristic of the genus, which is intermediate between the true squirrels and the muridæ or true mice. Like the former the fossil species was probably a climbing animal, and if we are to judge from the habits and haunts of its pigmy congeners of England and the southern form (*M. glis*), which inhabit dense shrubberies and copses, building their nests in thickset hedges and together in little colonies, it may be surmised from the vast quantities of the remains met with in the situations described, that, independent of the means by which they were conveyed into the caves and hollows, there is a probability that the wholesale destruction of such vast assemblages, at all ages of their existence, from the newborn (Fig. 4) to the aged, would seem to point to a similar gregarious existence. The excessive numbers indicate a luxuriant undergrowth and predominance of cereals, soft nuts, and an arboreal vegetation inconsistent in the extreme with the present capabilities of the islands.[1]

As regards the Malak and Middle caves, I have before remarked that the dormice had been possibly introduced by owls and small predaceous animals, but with reference to Mnaidra, Gandia, and Benghisa, and probably Zebbug, it is clear that the causes which brought about the wholesale

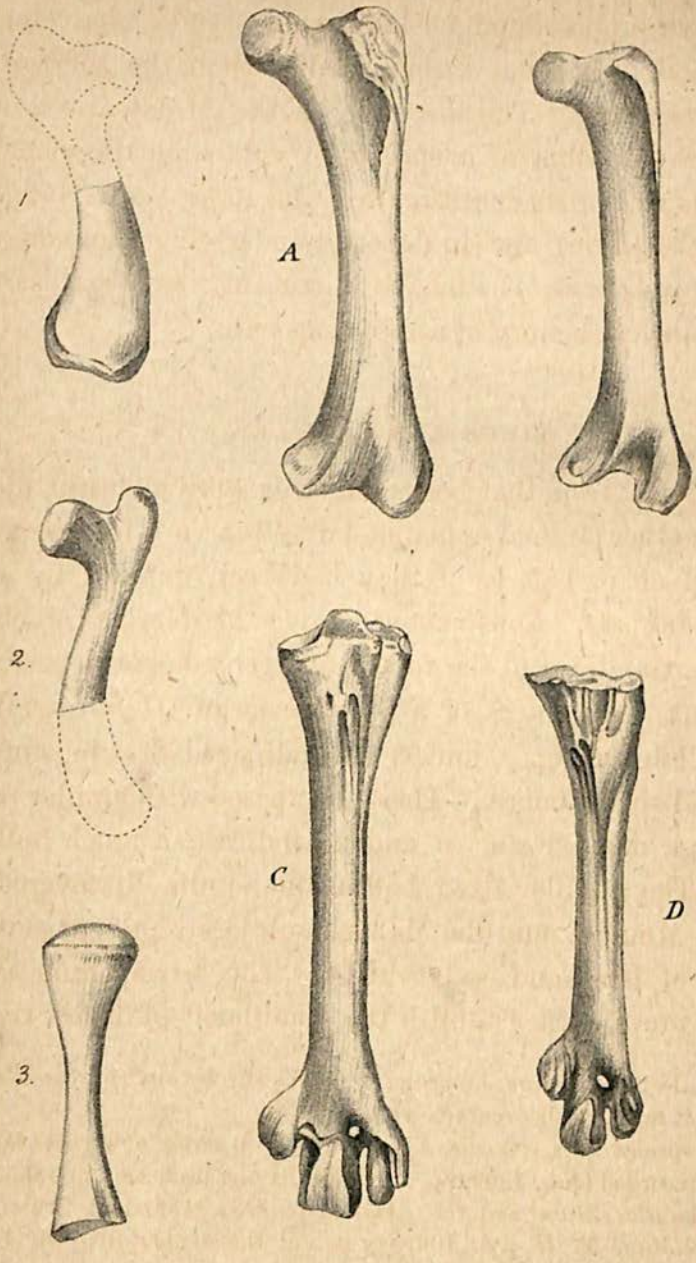
[1] Including even the entire cultivated districts, I do not think that combined they could produce sufficient natural subsistence for a tithe of the river-horses, elephants, and dormice represented by the exuviæ of even the Malak and Mnaidra deposits.

destruction of the pachyderms likewise affected them; and whilst their extinction was perhaps owing to the same influences, it is probable, from their excessive numbers, that they outlived the larger quadrupeds, and lingered on the island for ages prior to the final submergence of the area, if, indeed, the latter was at any time altogether depressed under the sea, which may be doubted, from several of the exact same species of land-shells of the period being now found in the islands. I repeat, the rationale of the finding of such vast quantities of dormice and birds' bones, either, as in the Malak, in fragmentary states, or, as in Mnaidra, entire, along with uninjured bones of elephants, or below and between blocks of stones in the old torrent-bed of Benghisa, together with their presence in almost every similar ossiferous deposit in the islands, seems to me conclusive that they cannot be accepted as representing the usual casuals from natural decay, but when taken in conjunction with what has been previously stated, they afford very strong circumstantial evidence that the extinction of the land fauna of the period was brought about by changes in the physical geography of the area—changes which must have been fatal to the welfare of such like animals, dependent on particular local conditions for their subsistence.

THE HOLLOW-JAWED DORMOUSE.

Myoxus cartei.

AMONG the rodent remains of the Malak cave, my friend Dr. Carte, F.L.S., pointed out to me, early in 1862, several lower jaws, having their under margins more concave, with the molars somewhat smaller, but not differing in any other respect from the *Myoxus melitensis*. (See Plate III. fig. 4.)



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FOSSIL BIRDS & REPTILES.

A. Thighbone (½ nat. size) of Cygnus Falconeri. B. Thighbone (½ nat. size) of Cygnus Olor. C. Shankbone (½ nat. size) of Cygnus Falconeri. D. Shankbone (nat. size) of Cygnus Olor. 1. Humurus (⅕ nat. size). 2. Thigh (⅐ natural size) 3. Tibia (¼ nat. size) of Freshwater Turtles.

Such being pretty constant in other specimens from Mnaidra gap, I have supposed might indicate a specific character in conjunction with bones rather smaller than the average of *Myoxus melitensis*. The discovery in the Middle cave of a lower jaw and tibia of a species of vole, undistinguishable as regards size or its dentition from the BANK VOLE (*Arvicola pratensis*,[1] Baillon), and in deposits underlying those of the *Myoxus melitensis*, is indeed important, as regards the palæontological history of a recent species.

BIRDS AND REPTILES.

WE have seen that bones of birds were plentiful, along with the other animal remains, but often very fragmentary, as stated at p. 183, as if they had been gnawed by predaceous animals. Conspicuous among the débris of Zebbug, Mnaidra, Gandia, and the rodent and river-horse deposits of the Malak, were traces of a gigantic swan (*C. falconeri*), of which Plate IV. fig. A and C are half-sized drawings of its thigh and shank bones. These, compared with similar parts of a large mute swan,[2] B and D, indicate a much bulkier bird.[3] The smaller-sized bones and skulls discovered in Zebbug, Mnaidra, and the Malak, doubtless represent several species of land and water birds. The latter, from their marked prevalence, establish the likelihood of lakes, rivers,

[1] I could not discover the presence of this species alive on the islands. If found, it must at all events be rare.

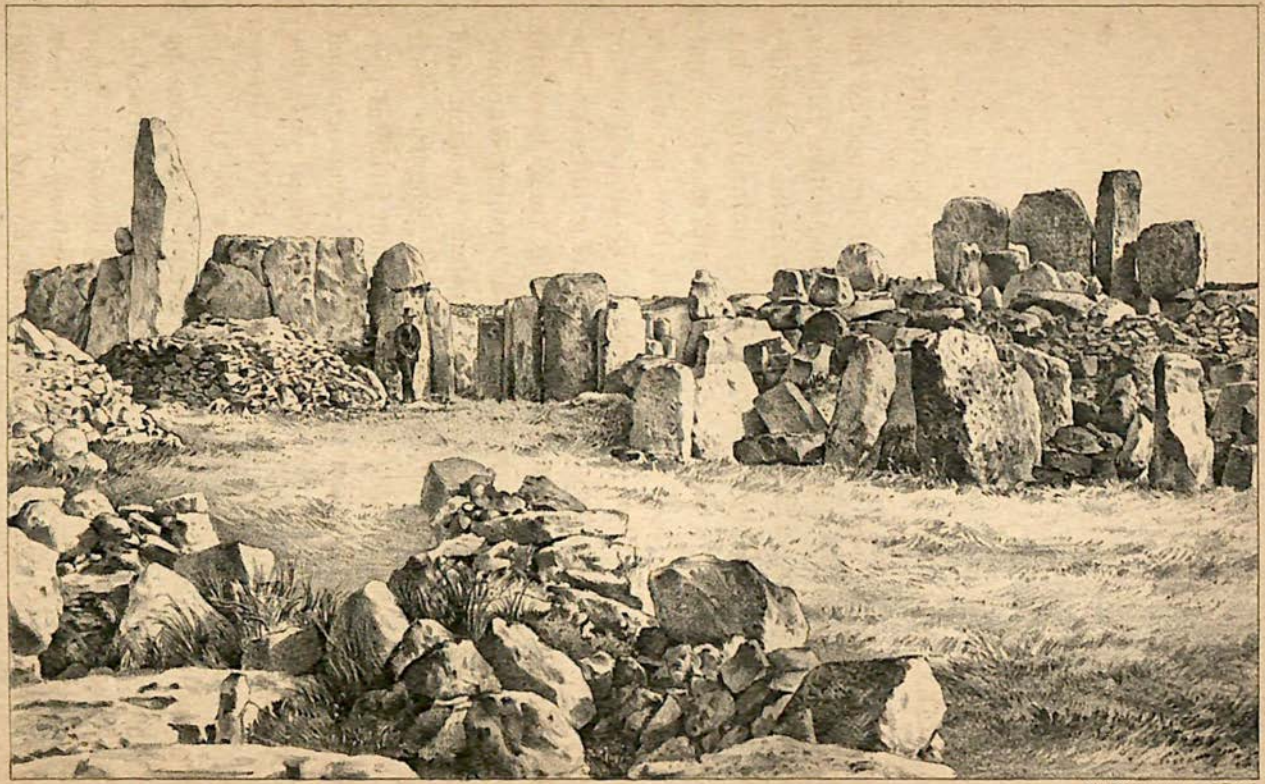
[2] This species (see Catalogue, Appendix, p. 280) rarely now visits Malta; a flock is recorded (*Ibis*, 1869, pp. 248, 250) having been seen in 1865, and both Loche (*Cat. Mam.* and *Oss. Algerie*, pp. 137, 138) and Drummond (*Ann. and Mag. N. H.* xvi. 109) say it and the hooper frequent North Africa in winter.

[3] See Parker, *Trans. Zool. Soc.* v. vi. 119. This is no doubt what Dr. Falconer named *C. melitensis*.—*Pal. Mem.* ii. 300.

or lagoons, which are further proven by undoubted remains of at least two species of fresh-water turtles, one of which was of large dimensions. The fragments of a humerus, femur and tibia, Plate IV. fig. 1, 2, and 3, indicate individuals of from one and a half to two feet in height,[1] fig. 2 being rather less than a fifth part of the natural size. Bones of a lizard, somewhat larger than the common North African and European chameleon, were plentiful in Benghisa gap.

Finally, the finding of a carnivorous incisor tooth in the Malak cave (Note 1, p. 204), besides indications of a ruminant and birds' bones in the deposits overlying the elephants' remains of the Malak fault (p. 188), together with the carnivorous tooth referred to by Dr. Falconer from Zebbug cave (*Pal. Mem.* ii. 306), all point towards future discoveries which would enable the palæontologist to fill up a fresh page in the highly interesting history of ancient Malta.

[1] Author, *Quart. Jour. Geol. Soc.* vol. xxii. p. 594.



W.H.M.c Farlane, Lith.r Edin.r

VIEW OF HHAGIAR KIM FROM THE SOUTH EAST.

PART V.

ANCIENT MALTESE MONUMENTS AND ROCK TOMBS.

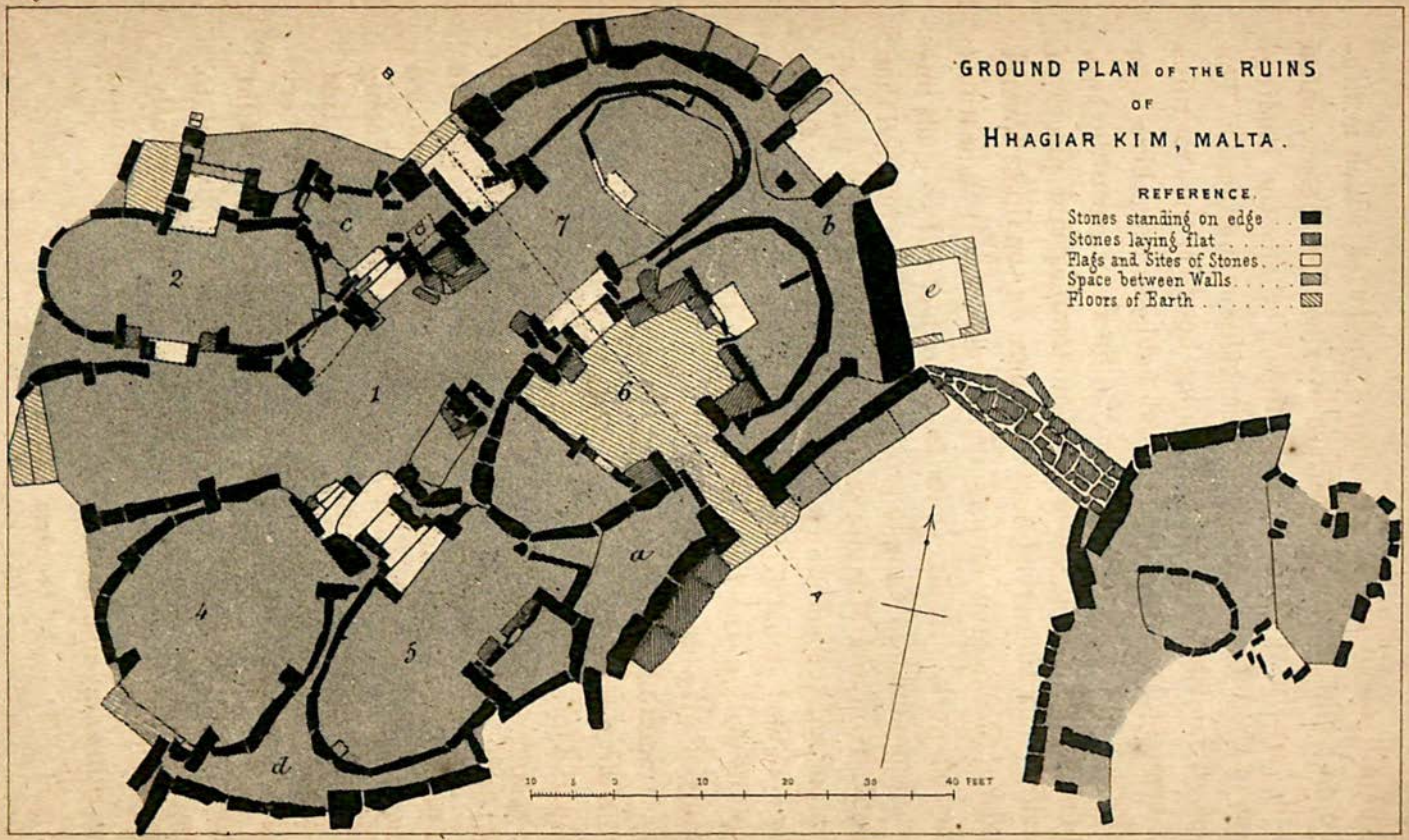
FROM what I have before stated with reference to the physical appearances and capabilities of the Maltese Islands, it will be apparent, as far as advantages in point of fertility are concerned, that they are remarkably uninviting; but their land-locked bays form excellent harbours of refuge, and, coupled with their mid-ocean positions, they must have presented great facilities to the early navigators, either for the extension of commercial relations or of conquest. The Knights of St. John, although proclaiming them bare and verdureless, soon perceived their value as "points d'appui" in their gallant struggles to stem Moslem invasion, and England, by assuming their protectorship, recognises their value with reference to the safe keeping of her Oriental possessions. Possibly, from first to last, they have been occupied only as depôts to recruit stores, and for strategical purposes. To the early Phœnicians, and subsequently to the Greeks and Romans, they formed admirable resorts for the war-galley and trading-vessel, but further they must of necessity have been very unimportant. Indeed, there was no incitement to agriculture, seeing that, excepting a few of the large valleys, all was a bare sloping sand or limestone, with their surfaces pot-holed, and no natural verdure beyond the wild

squill, artichoke, daffodil, and euphorbias, which thrive in suchlike sterile situations.[1]

Hhagiar-Kim and Mnaidra.—Along the south-east, southern, and round even to the north-east coast of Malta, in the various coves, harbours, and land-locked bays, there are ruins of ancient monuments of a similar style of architecture, and representative of the oldest non-historic remains met with in the islands. The position of many to these harbours of refuge might seem to indicate that the early colonists came originally from Africa; moreover, during the summer and autumn seasons, the prevailing winds being from the south and south-east, so that a vessel starting from Carthage would have been likely enough to fetch some portion of the southern coast, or missing it, would scarcely pass by Sicily, which, in clear winter days, is visible from Malta, from whence the eruptions of Etna have been seen.[2] The most suggestive of these ruined megalithic monuments are Hhagiar-Kim and Mnaidra. The former stands on the brow

[1] The palm, carob, acacia, etc., invariably become stunted unless properly sheltered,—the carob in particular, which, although fruitful, is generally exceedingly dwarfed and gnarled even in sheltered places. These facts make it probable that all the trees have been introduced.

[2] With reference to the early colonization of Sicily, it is recorded by Pausanias (Lib. v. c. 25) that it was peopled by the Sicani and Sicili and Phryges, the first having come from Italy, and Phrygians from the river Scamander, and the Troad. The Phœnicians and Libyans, from Carthage, came in a body. These he called the barbarian nations. Of the Greeks he mentions Dorians and Ionians, with a small number from Phocis and Attica. Diodorus mentions that it was the opinion of his countrymen that the first inhabitants of Sicily were frightened from the island by the eruptions of Etna; the Sicili from Italy came in their place. Afterwards colonists from Greece settled there, and conveyed the Greek dialect thither. Thucydides (Lib. v. c. 7) gives a more circumstantial account of the colonization of Sicily, which is nearly the same as that of Diodorus (Lib. vi. c. 2).


GROUND PLAN OF THE RUINS
OF
HHAGIAR KIM, MALTA.
REFERENCE.
Stones standing on edge
Stones laying flat
Flags and Sites of Stones
Space between Walls
Floors of Earth
B
A
1
2
3
4
5
6
7
a
b
c
d
e
10 5 0 10 20 30 40 FEET

of the hill, about half a mile above the latter, which is situated on a cliff or ancient terrace overlooking the sea, and a small cove in the Malak downthrow, perhaps the landing-place of the builders of these remarkable monuments. The slope of sandstone rock intervening between the two ruins has been broken up into terraced fields, so that there is no indication or record of a road or Via Sacra between the two, supposing we are to consider them temples and places of worship; but I observed here and there on the dikes several detached blocks of stone presenting well-marked indications of mason-work. At all events, from the fact of two such important monuments being in proximity, it may be inferred that Hhagiar-Kim and Mnaidra were close to, or formed part of, an important sea-port town. Indeed, it would seem that a village named Rahal Kbir (the great town) existed in their vicinities within the last three centuries. The important bearing of all this is, that the Maltese language, or rather dialect, contains several corruptions of Phœnician words, and that Kbir means "powerful or great" in both; moreover, Hhagiar-Kim signifies in the former "stones of worship," and seeing that it seems established that the village of Rahal Kbir stood there, according to M. Dozzina,[1] we have thus established convincing proofs that the Phœnicians had at one time or other been inmates of the monuments, seeing that the Cabeiri were the predecessors of the latter, and that the word powerful was derived therefrom; hence the very learned student of Maltese archæology, Dr. C. Vassallo, suggests that the temple was most probably dedicated to the Seven Cabeiri—a surmise which, we shall see presently, receives a further support from the number of idols found in the ruins and chambers.

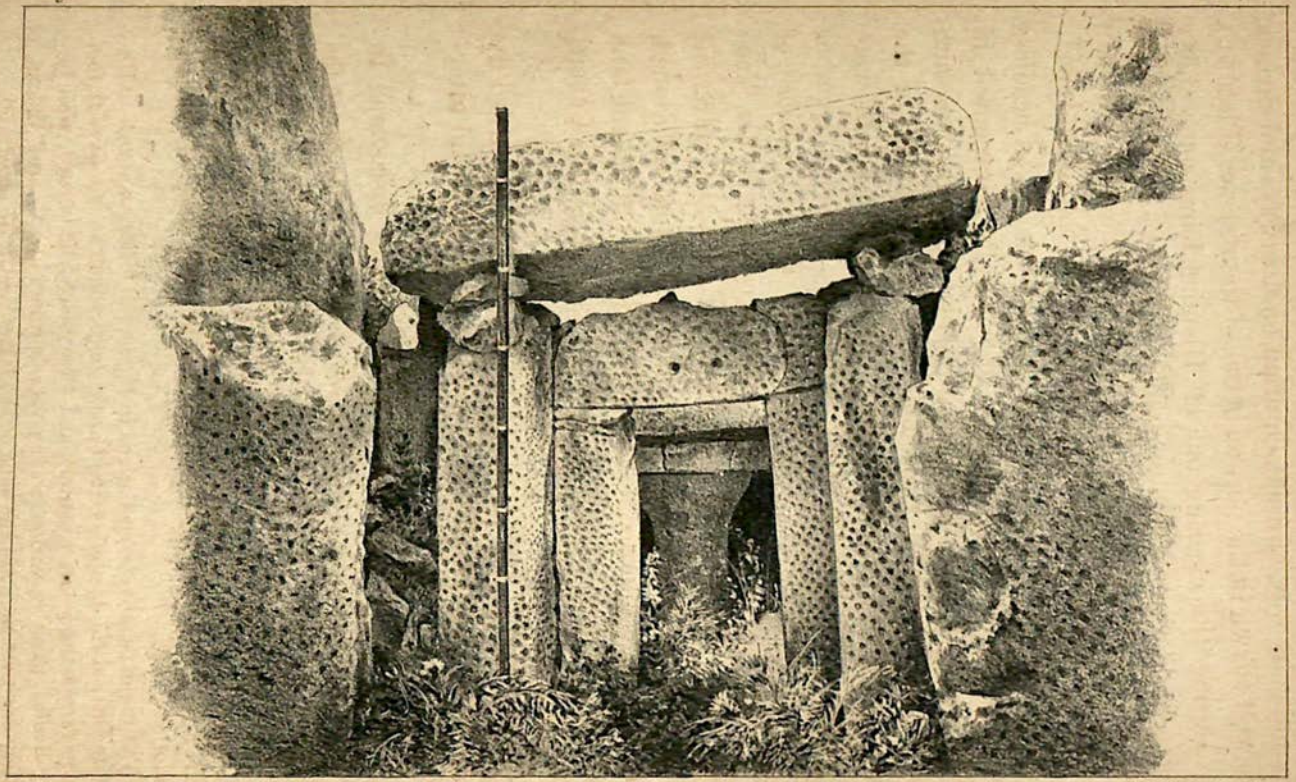
[1] See *Acta Visitationis.*

It has been doubted whether these monuments were open-air temples or covered in. In several of the chambers, both in Mnaidra, Hhagiar-Kim, and also in the Giant's Tower, Gozo, there is a decided contracting or beehive construction. This is very apparent on the walls of chambers 6 and 7, Plate v., showing the ground-plan of Hhagiar-Kim; moreover, I perceive this opinion corroborated in a very learned article on the Pre-historic Cross,[1] where the writer likens the cyclopean temple within the tumulus of Newgrange, on the banks of the Boyne, to the so-called Giant's Tower of Gozo; for the reasons that in both the emblem of the cross, conjoined with the paradisiacal mount,[2] is preserved within the pile rather than without, for the preservation of them, from the elements; being in both almost exclusively constructed of earth. The above plan of the interior of Hhagiar-Kim, the most perfect of the non-historic and megalithic remains met with on the islands, shows a series of oval-shaped apartments, with smaller recesses leading off, and what might be considered shrines and sacrificial altars.[3] Conjointly, all are of rude workmanship. Like Stonehenge, the blocks are usually standing on end, but in several places they lie horizontally, either on the top of the former, or generally so placed from the foundation upwards. Excepting in rare instances, there is not even an attempt at decoration or writing on any of them. However, on Hhagiar-Kim, circular indentations or

[1] *Edinburgh Review*, January 1870, p. 248.

[2] The ancients expressed the situation of *paradisiacal earth* in reference to the sea.

[3] The dimensions of the various chambers are as follows:—chamber 1 = 65 × 14; 2, 3, 4, and 5 = each 32 × 17; chamber 6 = 44 × 18; *a*, *b*, *c*, and *d* are recesses; *e* seems to be portion of a completely dilapidated building, not now traceable, except by its monoliths and blocks lying about in great disorder.



W.H.M.Farlane, Lith. Edinr.

ORNAMENTED SHRINE IN HHAGIAR KIM.

dimpling, by way of ornamentation, on doorways and shrines, are well shown in the portion of one of the recesses (Plate VI.).

During the clearing out of Hhagiar-Kim, some thirty years ago, there turned up among the débris of one of the chambers a skull and portions of the skeleton of a human body, displaying well-marked characters of the negro type.[1]

But the objects of greatest interest were seven headless and similar dwarf images, one of which is represented in Plate VII. fig. 1. The peculiarities displayed by these uncouth forms, were an oval development of the various parts of the body; however, that the Cabeiri of the Phœnicians were so formed does not appear from history; still, the number found being *seven*, corresponding also with the *number* of chambers in Hhagiar-Kim; further, according to Dr. Vassallo,[2] there are *seven* detached monoliths at the entrance; these, and the fact of the ancient village just mentioned, renders it highly probable that at all events the Phœnicians used the ruin as a temple. Herodotus assimilates the Cabeiri to Vulcan.[3]

In addition to the idols just mentioned, there turned up in Hhagiar-Kim on the same occasion the slab and altar-piece represented in Plate VII. fig. 2 and 3.

Unfortunately, the majority of antiquities discovered in

[1] Most probably this body was interred within the ruins during the days of the Knights of St. John, seeing that Ethiopian slaves were then numerous in all Christian and Mussulman possessions.

[2] *Art Journal*, 1853, p. 221; and brochure on the ancient Maltese monuments. Ancient authors differ however as regards the number of Cabeiri; according to Mnaseas they were four. See Larcher's Com. on Herodotus, p. 268.

[3] Talking of Cambyses' spoliations in Egypt, the historian says:—"He likewise entered the temple of the Cabeiri (into which it is unlawful for any one except the priest to enter), and their images he burned, after he had ridiculed them in various ways; these also are like that of Vulcan, and they say that they are the sons of the latter."—III. 37 and II. 50.

the islands have been taken away by private individuals, so that the student only learns by hearsay of such remarkable objects as the phalli referred to by the author of the article just quoted.[1] These objects, according to him, formed the ideal from which the famous Maltese Cross originated; and seeing that this is, as far as I know, the first precise enunciation of the origin of the latter, I here quote his words:—"The form of cross known as the Maltese was common to both hemispheres. In Assyria it was the emblem of royalty *par excellence*, and typified the elysium of the four great gods of the Assyrian Pantheon, and when inserted in a roundlet was emblematical of Sansi, or the sun dominating the earth as well as the heavens. The title by which it is distinguished in our day was derived from a too conspicuous representation of it in Malta, where four huge phalli, carved out of the solid granite, but which were subsequently metamorphosed by the virtuous Knights of St. John, served for their arms. Other examples of it, in similar fashion, occur in the same locality, and in the adjacent isle of Gozo; all of which were the handiwork, no doubt, of early Phœnician colonists. In an equally gross manner it is displayed in Etruscan and Pompeian monuments."

An object resembling the Maltese cross meant the planet Venus (*Chasca*), amongst the Inca Peruvians. Their astrologers noted its movements, and venerated it as a page of the sun. The Incas had in Cuzco a similarly formed cross of white and red marble, three-quarters of a yard in length, which was held in great veneration.[2] In the ruins on the island of Coati in the Lake Titicaca, are several crosses on

[1] *Edin. Review*, p. 234.

[2] See Bollaest's *Antiquities of South America*, p. 146; Wilson's *Prehistoric Man*, p. 363; Layard and Rawlinson's *Assyria*, etc.

1.

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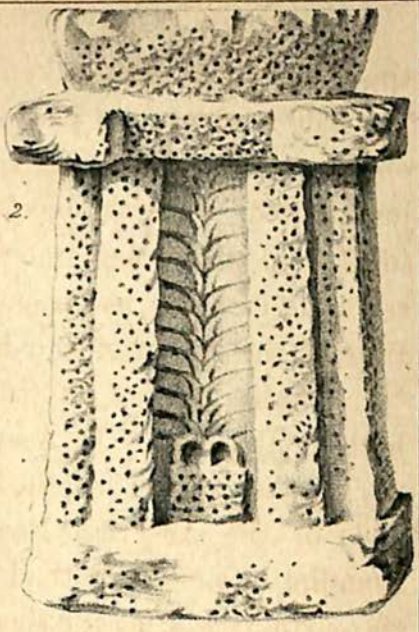

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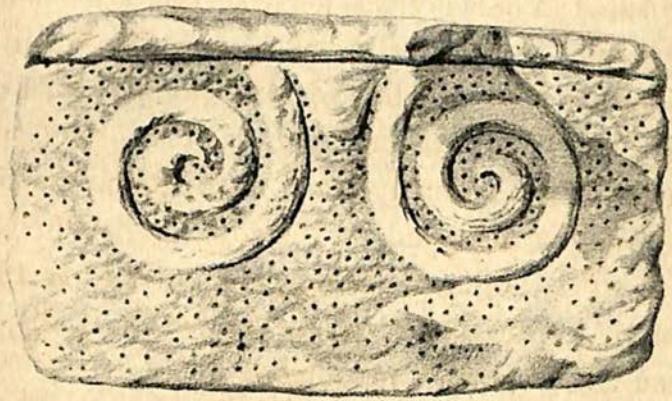

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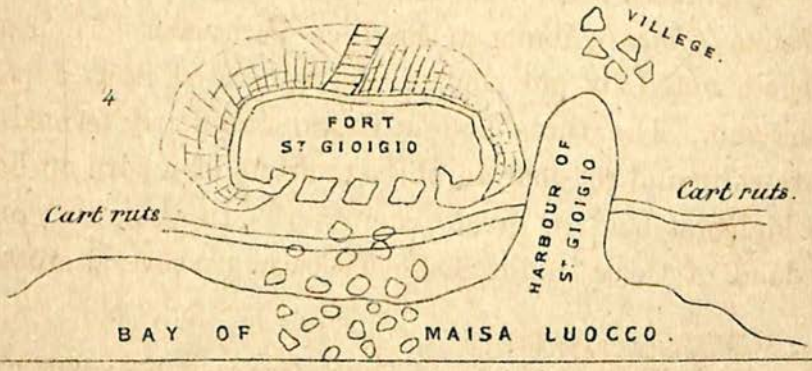
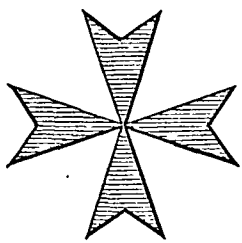
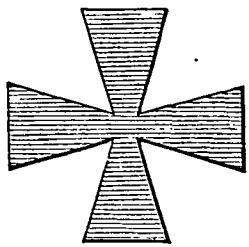


IDOL, ALTAR SLAB, &c

the walls. It is also seen on vases; and the stone pan-pipes found in a tomb at Cuzco had twelve Maltese (like) crosses.[1]

But I am reminded by Mr. Hodder Westropp, who has devoted close attention to this subject, that, as shown by





the accompanying figures of the Maltese cross of St. John and the so-called Maltese cross above mentioned (on Assyrian and Peruvian antiquities), there is a marked difference between the two, inasmuch as the former is composed of four spreading arms like fish-tails jointed at a small centre, whereas the other is a cross patée, and is often called the eight-pointed cross.

So much for the Maltese cross and its affinities. What had the religion of the Incas to do with Christianity? And whether or not the virtuous Knights of St. John borrowed their badge from the immodest phalli on the rough-hewn blocks of Malta and Gozo, we must not lose sight of the facts that the Maltese cross is a simple figure, and easily represented in design and sculpture, and that a figure like it existed as an ornament and emblem ages before the Knights of St. John set foot even in Palestine. Indeed, as suggested by De

[1] The Phœnician god Baal being said to have been symbolized by a conical obelisk of stone, the discovery of a somewhat similar one in Malta disposes Sir J. Lubbock to ascribe the ancient ruins to the Phœnicians, and from other decorations to refer them to the bronze age period.—*Prehistoric Times*, p. 47.

Quincey, " the associated circumstances of storm and solitude, of winter, of night and of wayfaring, would give dignity to almost any form which had become familiar to the eye, as appropriate to the purpose."[1]

The carved objects on the slab (Plate VII. fig. 3) may represent the serpents which were the emblems of the procreative power, and the oval-shaped developments of the idols and chambers seem also to bring their construction still closer to the Phœnicians, who are said to have adored the universe under the semblance of an egg. I have repeatedly picked up fragments of charred bones and teeth of sheep, pigs, and dogs in many of the chambers; indeed, among the débris removed from Mnaidra on the occasion of its clearing out, there is now no difficulty in recognising such remains in abundance; and coupled with evident signs of fire on several of the altar slabs, seem highly suggestive of the temple nature of the buildings, the most perfect of which seem to be only portions of much larger structures.[2]

Now, with reference to the probable dates of the erection of these megalithic ruins, judging from their workmanship,[3]

[1] The well-known modern traveller Huc, when pushing his way through Central Asia, seems to have indulged in the pleasing belief that he sanctified, nay, consecrated, many a bleak and inhospitable Tartarian steppe by simply erecting a cross at his various halting-places. See *Travels in Chinese Empire, Tartary, and Thibet.*

[2] So-called Phœnician or Punic coins have turned up in Malta from time to time. Mr. Kenwick, in his work on Phœnician antiquities, observes that one coin of Phœnician origin was discovered in the islands, representing Osiris, the Egyptian Jupiter, on one side; however, none that I am aware of date beyond the Ptolemies.

[3] Rudeness is faithfully impressed on all parts of the buildings, and is even more pronounced in the Mnaidra and the Gozo ruins; for example, the miserable attempts at linear outlines in the formation of altar slabs, doorways, etc., the roughness of opposing surfaces of blocks, modes of making perforations on doorways, dimplings on the walls, as seen above. Thus, in perforating a block for the purpose of making a rope-hinge or

they are fully entitled to claim a very great antiquity, and might well have been erected long before the rise of Carthage, at all events long before the time of Diodorus Siculus,[1] who wrote thus of the islands:—"The inhabitants are a colony of the Phœnicians, who, trading as far as the Western Ocean, resorted to this island on account of its commodious ports and convenient situation for a sea trade; and by the advantages of this place, the inhabitants presently became famous both for their wealth and merchandise." In Paphos there are said to be Phœnician shrines similar in construction to those seen in the Maltese ruins, but no other extant memorials of this maritime people bear any similarity to these primitive and unique monuments.

Giant's Tower of Gozo.—Inland about two miles, on the side of the Sciacca plateau, overlooking the fertile valley of Ramala, which opens on the bay of the same name, is situated the so-called Giant's Tower,—the most cyclopean of all the Maltese monumental structures.[2] It is built on the same principle as the others, so that a description of Hhagiar-Kim will suffice for the general elucidation of their modes of construction and style of architecture. It has been a subject of frequent remark, considering the rude workmanship displayed on the buildings, that the modes of conveyance must

fastening to a door, they attacked the pillar on opposite sides, until the borings met in the centre, such as we see on the flint tools of the stone age. The above, however, may have been the first attempts of the original builders, whilst the better workmanship of the idols, altar, etc., and the rock-cut tombs of Mnaidra, may have appertained to an advanced period of their civilisation.

[1] B.C. 60, Lib. iv.

[2] Some of the largest upright blocks of this ruin measure 26 to 28 feet in length. In Hhagiar-Kim a few are 24 feet in length.

have been very effective, to have transported huge monoliths of a very friable rock for long distances; but this is more apparent than real, inasmuch as I found that there are few if any of the monuments which have not been constructed from rocks in their immediate vicinity, as is well seen on the sandstone about Hhagiar-Kim, where the ancient trenches around the mass of stone to be removed were dug in the exact same way as now practised by the Maltese. It has always appeared to me that the transport of the largest blocks is more suggestive of the numbers of inhabitants on the islands at the time than remarkable for their modes of conveyance and machinery used in placing them in their present situations. In the case of the Gozo monument, it must however be stated that the nearest possible situation where the sandstone blocks could have been obtained is fully half a mile distant.

Dolmen-like ruin on Corodino Hill.—Overlooking the Grand Harbour of Valetta there are remnants of small chambers, mostly formed of erect blocks not exceeding 3 to 3½ feet in height. These being remarkably small as compared with any of the above-mentioned blocks, may represent what has been named an uncovered dolmen; they however enclose no subterranean sepulchre, and are not surrounded by circles of stones, or any vestige of the kind. Around the eastern coast of Malta there are observed isolated blocks standing on end, and here and there, on the slopes and hollows around Marsa Sirocco, may be traced what had at some time or other been extensive ruins similar to the temples, but now cleared away by the farmers to form dikes, and rid their little fields of encumbrances.

In a field a little to the north of Har Hassan cave, on the

south coast of Malta, is to be seen an erect monolith, with no remains around it. Whether this is a solitary block of a former monument, or one of a series of similar blocks, cannot now be ascertained.

Malcarte and Submerged Rock-Pits of Marsa Sirocco.—Diodorus mentions that a temple dedicated to Melcarth was erected in Malta by the Phœnician colonists. Whether the ruin which to this day passes under the name, on the slope overlooking the great bay of Marsa Sirocco, is the one to which the historian refers, it is impossible to say, and we are further prevented from arriving at any likely impression on the subject by the circumstance that the moderns have done their best to completely overwhelm and destroy this and other venerable monuments of antiquity, by either removing the walls, or by carting stones and rubbish on them. In the case of Malcarte only a fragment of a chamber is visible, the remainder being covered over by a hill of loose stones collected from the neighbouring fields.

On the beach of the little creek called St. Georgio, under the above-mentioned ruin, and in front of a little battery, as seen in Plate VII. fig. 4, are observed some seventy to eighty caldron-shaped fossæ, from four to five feet in depth, a few of which are permanently submerged, whilst during a sirocco all are more or less subject to become inundated. Moreover, deeply indented cart-ruts run across the mouths of several, and end abruptly in the little creek, reappearing at the opposite side, at a distance of nearly two hundred feet apart. Cavities apparently in no way differing from the above, and also crowded together, were discovered in making a road to the fort of Rabatto Gozo in 1864, and were minutely examined by Dr. C. Vassallo and myself. The

general opinion has prevailed that these troughs were store-pits, and, in the case of the latter, from communicating with each other, were perhaps also used by the natives as hiding-places when the islands were ravaged by pirates during the middle ages. With reference to the Malcarte cavities: from their present position it has been surmised by several observers that they indicate a local sinking of the land; but I found, on comparing the dimensions of the rock-caldrons submerged with the others above the sea-level, that the sea is gradually intruding on the coast by the wearing away of the soft strata, so that a perpendicular section from the fort through the caldrons on the beach and under the sea would show that the latter are much shallower than the ones above. Whether the rock-ruts running across them were formed before or subsequent to the excavations is not certain; at all events, as they end abruptly on each side of the little creek of St. Georgio, it is clear that the latter has been formed since this old coast road was in use. The antiquity of these troughs may be great; by the natives they are said to have been the oil-stores of an early race, and are of the age of the Malcarte ruin.[1]

Indications of a greater modern extension of the Islands.—There are several indications of the rapid degradation and gradual breaking up of the strata in other situations. At Marfra, opposite the islet of Comino, deep cart-ruts are observed running across the limestone rock, and ending abruptly on

[1] The rock cavern named El Dalam, situated on the face of the valley of St. Georgio, and opposite Malcarte, runs for many hundreds of feet through the limestone rock. It is much obstructed towards its entrance by stones and rubbish. No doubt if properly explored there might turn up in its numerous tunnels objects interesting both to the antiquarian and geologist.

the edge of a precipice sea-ward. Again, on the edge of the plateau to the north of Fommer Rih Bay, there are similar conditions, showing also a breadth of axle almost equal to the modern Maltese cart. They run to the edge of a sea-cliff some 80 to 100 feet high, under which detached masses are lying about, thus also showing an extensive disappearance of the coast since the cart-ruts were formed. The degradation going on along the shores in this neighbourhood is very apparent, and in the manner I have referred to when describing the various strata and their denudations. Close to the marks above noticed there are several indications of lime and mortar structures, probably of a Greek or Roman origin. Similar ancient cart-ruts are noticeable in other parts of the islands.

ROCK TOMBS.

PERHAPS it may have been the scarcity of wood and scanty alluvial deposits that more or less necessitated rock sepulture, not only in the case of the early inhabitants of Malta, but in Egypt and such like countries, where arboreal vegetation is scanty. The difficulties in connecting the Maltese tombs with the builders of the megalithic and cyclopean ruins are complicated by indications on several that seem to point to their successive occupation by the divers conquering races. Again, no true sepulchres of the early Phœnicians are known wherewith the following might be compared. There are few of the great valleys and gorges of Malta that do not contain sepulchral vaults made in the rocks, the best examples being the catacombs of Citta Vecchia, Micabba, Tower Nadur, St. Paul's and Melleha Bays, and Mnaidra, besides detached crypts in various other situations.

One of the most characteristic and perfect of these subterranean burial-places is that illustrated on Plate VIII.

The rock-cut tombs of Mnaidra are situated on the brow of the hill about a quarter of a mile to the west of the ruins of the so-called temple of Mnaidra (see Map), and within a shorter distance of the fossiliferous deposits described. As will be observed, Plate VIII. fig. 1 A and *a*, there are two small arched openings in the calcareous sandstone, the former being the entrance to the one I shall now describe. The other, *a*, has a hemispherical niche over its arch, probably intended for a tablet, as the red cement is still adherent to the surface. This crypt is a simple vaulted chamber 4½ feet long by 4½ feet broad, and only 2½ feet in height. There are the two usual excavations on the floor for the heads of as many corpses as seen in the other graves. Probably it was the beginning of a series of tunnellings such as are represented in the Figures 2 and 3 illustrating the interior of its sister opening, Fig. 1, A, which leads by a few steps into a long passage, of which Fig. 2 represents a vertical section with the openings into the various crypts on its right and left (B and C).

There is, moreover, another tunnel running at right angles to the last (Fig. 3, *b*). On each side of the doorway (Fig. 2, *d*) is a small niche in the wall, most probably for a lamp, which seems to have been placed also in the interior of the crypts, sometimes two were placed over the heads (Fig. 3 *e*, 1, 2, 3, and 4). In Figure 2, 4, there appears an abandoned vault half completed, and another on the opposite wall has been little more than begun. All the crypts resemble one another, averaging 5 feet 3 inches in length by 3 feet broad at the centre, and from 2½ to 3 feet in height; or, in other words, they are broadest at the shoulders, and

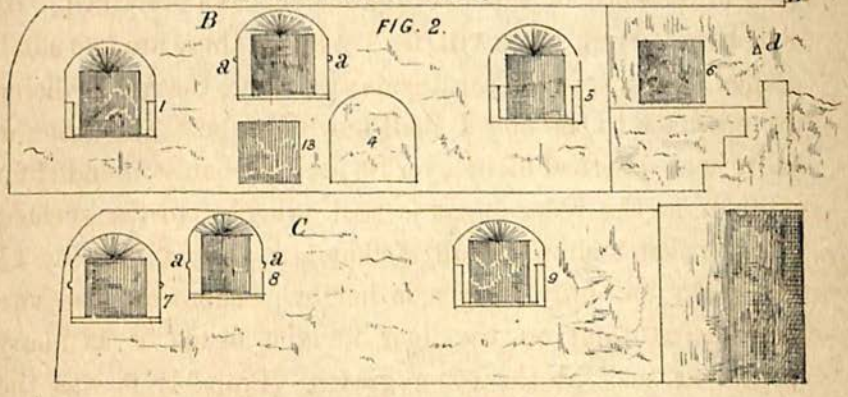
ROCK TOMBS NEAR MINAIDRA.

ENTRANCE TO THE SEPULCHRAL VAULT.

FIG: 1.

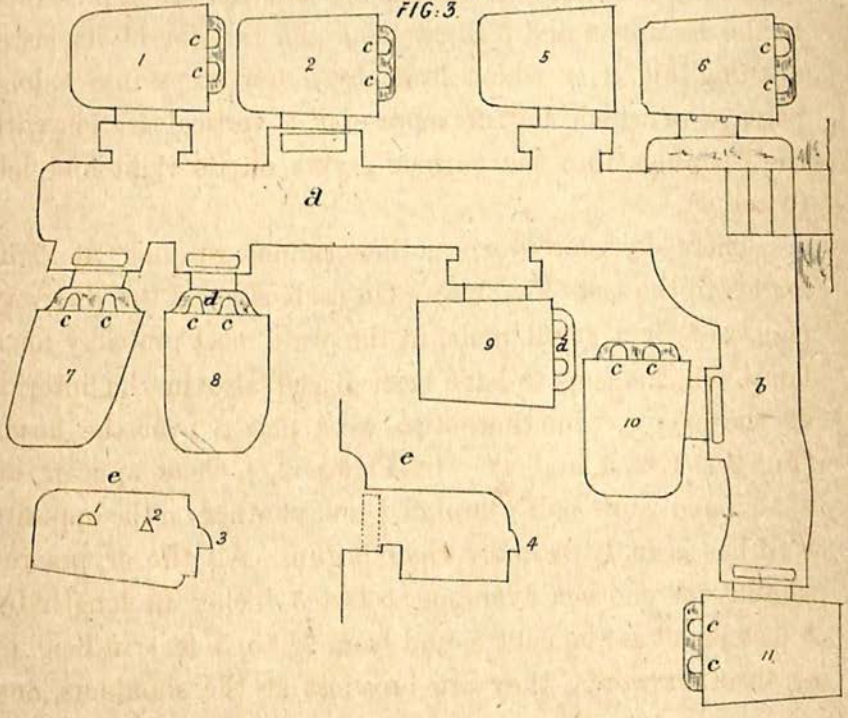
GALLERY OF SEPULCHRES SHOWING OPENINGS TO THE VARIOUS TOMBS ON EACH SIDE OF THE CENTRAL PASSAGE.

FIG. 2.



GROUND PLAN OF THE ROCK CUT TOMBS NEAR MINAIDRA.

FIG: 3.



ANTERO POSTERIOR AND TRANSVERSE SECTIONS OF INTERIOR OF TOMB

narrower towards the feet. Each was intended for two bodies placed side by side, the head resting in the ovals *c c*, Fig. 3. In one or two crypts I noticed a small circular hollow, about 2½ inches in diameter (see Fig. 3, 8 *d*, 9 *d*). No doubt the entrances to the crypts were closed by slabs, as the cement along the sides of the square openings sufficiently indicate; moreover, the niches in some (Fig. 2, *a a*) show that they may have been temporarily or permanently kept closed by means of slabs held in position by cross bars. Although the digging displays rather primitive-shaped instruments, still, from the blows of percussion indicated on the walls, the tools must have been keen-pointed, and very effective.

The arch of crypt 5, fig. 2, is here represented (Plate IX. fig. 9) on a larger scale.[1] It is the only one containing any ornamentation, and that being a series of scollopings or rays which diverge from a common centre, and painted a brick red colour. Whether to consider this as the work of the original hewers of these tombs, or additions made by the Arab, Greek, Roman, or Christian invaders, is extremely doubtful.[2]

Ancient Maltese Tomb and Shrine.—During the winter months of 1865, in conjunction with Mr. Welch, I instituted a careful examination of the neighbourhood where the first series of tombs exist, and after some time spent in surveying every probable situation, we were rewarded by the discovery

[1] I am greatly indebted to my friend Mr. Welch, not only for these accurate delineations, but also the plans of the next tomb and shrine.

[2] Bishop Errington, who has devoted much attention to the antiquities of Italy, Southern Europe, and Northern Africa, examined the vaults with me in 1863, and was of opinion that this mode of architecture and the ornamentation on the arch (Fig. 9) indicated a far more recent period than what would be represented by the builders of Mnaidra and Hhagiar-Kim.

of the following interesting rock-cut sepulchre and altar, which, on being cleared of the soil with which they were more or less filled, presented the following appearances. They are situated on the brow of the hill, a very short distance to the north of the Mnaidra tombs.

The sepulchre (Plate IX. fig. 5) is a coffin-shaped excavation in the calcareous sandstone, of the dimensions given in the various sections, and sufficient for the reception of the body of a person not over 5 feet 10 inches in height, with an allowance for the covering of the body by slabs of stone. Thus it was simply a hollow on the surface of the rock. Parallel, and only separated by an intervening thickness of rock of about ·9 inches, and pointing northwards, was a cavity, the surface outline of which is shown by Fig. 6, whilst its perpendicular section (Fig. 7) displays at the southern extremity a series of steps leading to the floor, with the opposite or anterior wall hollowed out like a scallop shell. This oval-shaped recess, it will be observed, is entirely separated from the general cavity by two ridges, forming a framework which was intended for the reception of a perpendicular slab to shut off the one from the other. Thus we could suppose the worshipper, by descending the steps, could remove the slab, and present his votive offerings, or perform the funereal rites. The remarkable features observed in both the tomb and shrine were the niceness and regularity wherewith the various details had been carried out, whilst the shallow coffin would lead to the belief that unless the body had been embalmed, a stone slab would have scarcely secured sufficient covering to have prevented the disagreeable results of decomposition. Whoever were the people that dug this strange and (at least as far as Malta is concerned) unique grave and altar, it is clear that,

ANCIENT MALTESE TOMB AND SHRINE.

FIG. 5

FIG. 6

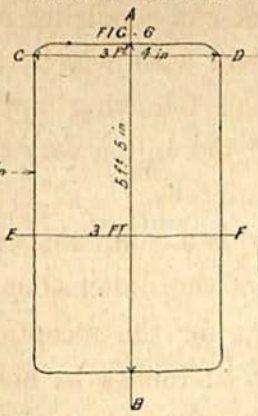
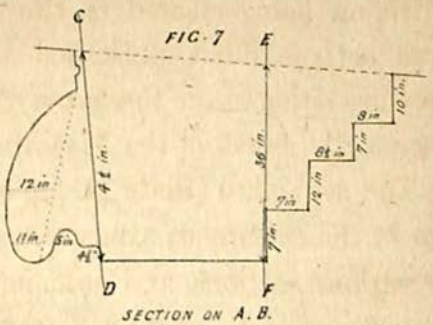
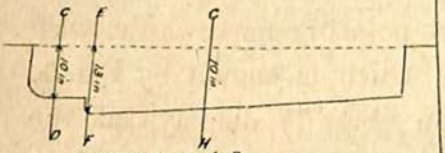


FIG. 7



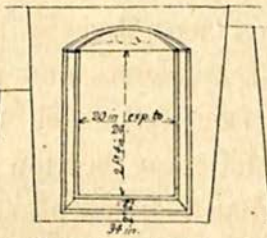
SECTION ON A. B.

FIG. 5.



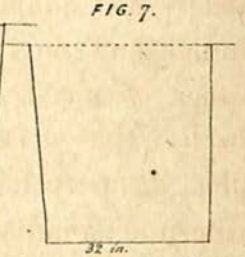
SECTION ON A. B.

FIG. 7.



SECTION ON C. D

FIG. 7.



SECTION ON E. F.

FIG. 5.

SECTIONS ON C.D. E.F. G.H.

Scale - ¼ inch to the Foot.

FIG. 8. 2'.4"

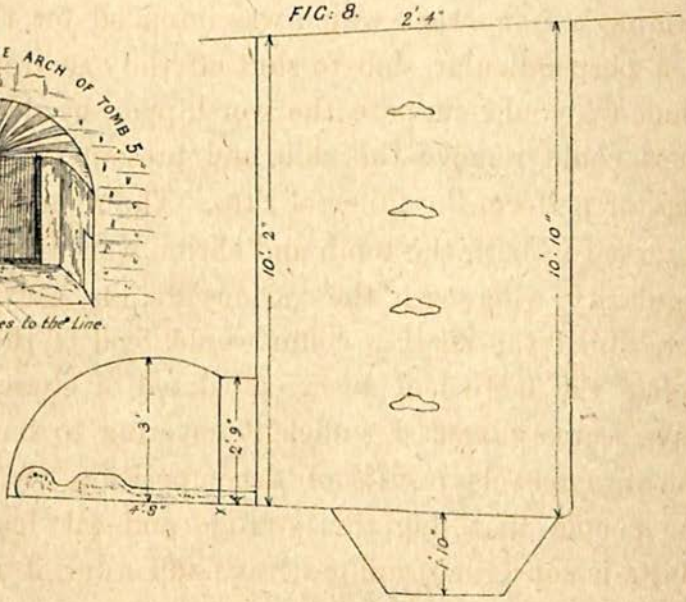


FIG. 9.

N.B. Scale 12 inches to the Line.

ANCIENT BURIAL VAULT DISCOVERED AT TALL HOR, (NEAR VALETTA.)

like those just described, they represent an amount of architectural skill we see nowhere displayed on the temples; and therefore it is probable that they were constructed by a more civilized race of human beings than the rude builders of Hhagiar-Kim and Mnaidra, in their immediate vicinity; whilst, on the other hand, viewed collectively, they would seem to indicate that this portion of the south-east coast of Malta was for ages inhabited by distinct colonies of human beings of whom history furnishes only scant notices.

Ancient Burial Vault at Tall Hor.—The following remarkable sepulchre was discovered in 1865, when forming a cemetery on a rising ground at the top of the Grand Harbour of Valetta. It is represented in Plate IX. fig. 8.

It consisted of a square perpendicular shaft, in which are cut four niches, evidently intended for ascent and descent. At the time of discovery, it was filled with earth and fractured portions of the calcareous sandstone in which it exists. The first human skeleton was found within a few feet of the surface, and from its appearance indicated a young person. In the oval chamber at the bottom of the shaft lay two entire human skeletons, side by side, in a horizontal position, without seemingly any trace of vesture whatever. Along with them were found an urn of well-baked clay, containing *charred* bones; also two narrow-mouthed vessels of rather elegant shapes, but differing entirely from the Greek and Roman vases hitherto discovered in the islands. Each contained two small pieces of a light blue mineral substance in a state of decomposition. The skulls indicated that they belonged to aged individuals, from the absence of the chief cranial sutures, and the loss and attrition of the teeth. The developments of all were in no ways remarkable, and displayed

a well-formed facial profile, excepting perhaps a slight projection of the upper maxillary bones.

Catacombs of Citta Vecchia.—In Citta Vecchia, the ancient capital of the islands, there is a series of rock tombs, or catacombs, as they are called, extending under ground, and hewn out of the soft stratum of the upper limestone on which the city is built. The numbers and compass of this heterogeneous labyrinth of passages, crypts, and recesses would seem to indicate that the head-quarters of the ancient rock-diggers was in their immediate neighbourhood. Several other excavations referable to about the same period have been discovered on the face of the plateau and vicinity of the city; and probably St. Paul's Cave[1] may have originally been of the same order. The entrance to the catacombs is by a perpendicular shaft, when a few steps bring you into a series of tunnels running in every direction, with crypts on each side, and at all possible levels.

The outlines of nearly all the passages and their vaults have been more or less injured by subsequent occupants of the burial-place, which was used as a place of refuge during the middle ages, when the islands were subject to the sudden irruptions of predatory hordes.[2] The passages are usually

[1] It is a rough-hewn cavern under the foundation of a chapel in the city, and, according to local tradition, was the residence of the apostle during his sojourn in the island. There is nothing remarkable whatever in its appearance, further than an exquisite statue of the saint in semi-opaline marble stands in the middle of the cave.

[2] These two small islands, the most southerly points of Europe, have changed hands far oftener perhaps than any spot on the face of the earth, considering their very uninviting facies and capabilities. It seems doubtful if Homer refers to either one or other by Hyperion and Ogygia. The Phæcean myth discarded, we find the Phœnicians in the islands as early as B.C. 1519. They were expelled by the Greeks, B.C. 736; the latter

low and narrow, requiring the visitor to stoop when examining the numerous coffin-shaped receptacles, which vary in size and dimensions, but are for the most part similar to those subsequently to be described in the Nadur valley, distant about four miles. The usual descriptions were evidently designed for two bodies, and occasionally what might be supposed to have held the corpse of an infant is observed leading off from them. Soil is met with in several, where a few skeletons were discovered, but perhaps none of the latter belong to the original race who fabricated the catacombs In one tunnel there is a large hollow slab of rock, with a convex one close by, evidently for grinding corn, and possibly carried there by refugees.

The rock is rent by innumerable fissures, several of which

naming the larger island Melitas. Next, the Carthaginians expelled them. Attilius Regulus plundered the island during the Punic War They were lost, and retaken by the Romans subsequently, under whom they gained repute for the quality of their cotton and linen. The Vandals seized them about A.D. 454. The subsequent history is more or less obscure, until A.D. 870, when the Saracens made raids on the islands, and finally captured and plundered them. They seem about this time to have been a nest of pirates, and up even to A.D. 1090, when the gallant Count Roger expelled the corsairs. They subsequently passed into the hands of the Emperors of Germany; and finally, A.D. 1530, were made over to the Knights of St. John, from whom they were wrested by Napoleon I. 1798; and in 1800 came into the possession, or rather under the protection, of England—a connection I do not think, as far as their welfare and prosperity are concerned, can be said to have been other than most advantageous to all parties concerned. Scylax, the Carian geographer places the islands in Africa, but a British Act of Parliament has since declared them in Europe. With reference to the derivation of the name although generally supposed to have been of Greek extraction, the Hebrew signifying "to escape or take refuge," is similarly pronounced. The generality of the names of localities, towns, and villages are Arabic; so their dialect and rural songs. The facility wherewith natives can speak Syrian is well shown in the number of Maltese dragomans to be met with in Egypt and Palestine.

doubtless communicate with the surface, and put in motion the foul cavernous mephitic air which assails the visitor in many of the smaller tunnels.[1] Not a mark or scribble of any value has been discovered in the vaults. There are some notices, however, of pottery, but, like many of the records of the kind, generally are vague, and not very reliable. However, the soft porous rock was badly adapted either for sculpturing or burial, and unless the bodies were embalmed or shut up in air-tight coffins, it seems scarcely probable that the vaults, even when filled with soil, could have been generally used as a necropolis.

Catacombs much on the same principle,[2] but probably on a smaller scale, exist in the southern suburbs of the village of Micabba, whilst horizontal and perpendicular crypts are met with, either detached or in groups, along the sides of ravines surrounding Citta Vecchia and Rabbatto, in Gozo; also, as before remarked, along the St. Paul's and Melleha valleys, all testifying to the antiquity of these towns as sites of human habitations. Both Greek and Roman remains, in the shape of coins, statuary, pottery, etc., are preserved in sufficient quantity and conditions to testify to the continued occupation of the islands by them; but, strange to say, if the Phœnicians inhabited the area for a lengthened period, there has been little else than displayed by the megalithic ruins to attest their presence, if, indeed, we are warranted in

[1] From these circumstances there has arisen a native belief that the catacombs extend for enormous distances under ground. Several of the passages have accordingly been built up to prevent the possibility of visitors losing their way, there being convictions in the minds of the Maltese that one tunnel communicates with the ravine on the side of which stands Verdala Palace, a distance, as the crow flies, of fully two miles, whilst another runs all the way under ground to Valetta!

[2] The large catacombs of Syracuse, in Sicily, are identical in all features with the above.

ascribing these erections solely to this remarkable people, of whom we know little save through the literature of Greece and Rome, and long after they had played an important part in the early civilisation of the human race.

THE NECROPOLIS OF NADUR—MODES OF SEPULTURE.

At the top of the valley, near the Tower of Nadur, on the Benjemma plateau (see Map), there is an extensive series of rock-cut tombs in a sequestered spot, and on the opposite sides of a narrow rocky gorge. They embrace considerable variety of sepulture, being either simple crypts for two bodies, or chambers containing an indefinite number of burial recesses on their sides,—*i.e.*, sarcophagus-shaped receptacles; whilst smaller openings indicated possibly the locations for images or other ritualistic observances. No hollowed pillows for the head were observed in any, as in the case of the Mnaidra and other tombs, which were so dug out that the shoulders resting on the floor would be slightly lower than the head, as in the sleeping posture.[1] Like to Egypt, with the old rock-cut tombs of the Pharaohs during the early occupation of the country by the Christians, and as is the habit at the present day, the poorer classes of the Maltese have utilized many of the above as habitations for themselves, cattle, and the produce of their scrimp acres. Bronze imple-

[1] I have seen no rock-cut tombs in Malta displaying an outline so contracted as to lead to a belief that the corpse had been buried in a sitting posture; at the same time there are isolated crypts in ravines—for example at Marsa Scala, and in its neighbourhood—which, unless shrines, may have been used by the early colonists for some such purpose; moreover, cremation seems to have been practised, as is shown by what has just been stated, and a large quantity of charred human bones discovered in an urn in Gozo, and now preserved in the little museum in Rabbato.

ments are said to have been discovered at various times, but all have been carried away by visitors who happen to touch at the islands at the time when discoveries are made, so that the antiquarian finds little left save the immoveable objects. Many of the rock tombs were rifled from time to time, and their contents inspected by persons by no means competent to describe their appearances. No doubt the majority of the Nadur, Citta Vecchia, and other cemeteries, underwent a system of plundering similar to what obtained in Egypt, chiefly on account of any valuable or useful materials that may have been the custom to bury with the dead; there has been besides a general spoliation of the tombs and monuments by the ignorant and mischievous; and seeing that only of late years has there been any attempt on the part of the Government to collect or preserve the local antiquities,[1] we cannot wonder therefore at the scant information to be gleaned on the spot, or that the notices of discoveries should be diffused over a very wide field of literature.[2]

Sometimes the farmer, in forming a terraced field, or in digging for water, happens to hit on a sepulchre. I have accounts of several perfect crypts or tombs discovered in this way in St. Paul's valley, and in various parts of the highlands westward of Citta Vecchia. One description of burial presents the following appearance:—A shaft sunk in the rock

[1] A society was formed in Valetta in December 1865 for the better preservation of the monuments, and with the view of encouraging a taste for the local archæology and natural science.

[2] Besides the references before mentioned, there are several notices of Maltese antiquities in the transactions and journals of various continental nations. General Della Marmora gives a good description of the monuments in the *Nouvelles Ann. de l'Instit. Archæologique* (Paris, 1836). See also *Archæol. Zeitung*, 1848; *Archæol. Journal*, vol. ix. et vol. xiii. etc.; *Malta Penny Magazine*, May 1840, etc.

to the depth of seven or eight feet; it is about five to six feet long, and about three feet in breadth, and usually filled with soil and the chippings of the diggings, and there are a few niches for descent on one side, as seen at Tall Hor. On the bottom, a slab of stone covers the mouth of the sepulchre, under which lies the body on an elevated portion of the rock about three feet above the floor. Usually at the head there is a cup of well-baked pottery, with two handles. This no doubt was the drinking goblet. Close by the top of the bier there stands another with a cover but no handles, whilst a similar vase is at the feet. A little lamp made of the half-baked pottery, and similar to the common shallow oil-lamp in common use to this day in Syria and more eastern lands, is in a niche in the side-wall. The pottery, as a rule, was made by wheel, and betrays great taste and much elegance in shape, with no ornamentation save lines in black or red run round during their formation. Fragments of bronze and beads, also armlets of the former, are reported to have been met with, along with the above, in several of the Benjemma tombs exhumed of late years. This, although no doubt a very common mode of burial by shaft-digging, there seems to have been considerable modifications; as for example by the simple solitary horizontal crypt formed on the face of a ravine, where perhaps three or more bodies were often piled, one on the other, such as are observed in Egypt and elsewhere, and covered in with a close fitting slab firmly cemented round its edges. Thus in these ancient tombs we clearly observe that their owners had a full belief in a future existence. The tazza at the head of the corpse, with its two handles, mayhap contained water or wine, wherewith the soul refreshed itself on its journey to Hades, whilst the other vases may have held the food and offerings. Moreover, the

little lamp in the wall may have been lit on particular occasions to show off the swathed and mummied body, reclining as in sleep, with the head slightly raised on its stone pillow. Indeed, in all respects similar to the great event which characterized the dawn of the Christian era, there was either before or afterwards a custom in Malta of wrapping the body in linen and laying it in a sepulchre which was hewn out of a rock, and rolling a stone unto the door of the sepulchre.

No implements of stone or other materials, such as characterize elsewhere the presence of man in a savage or semi-civilized state, have hitherto been met with in any of the deposits; thus the boundary line between his antiquity or the area and the extinct animals we have been considering is still very broadly defined. Nevertheless, from the data furnished in connection with physical aspect, fauna, and capabilities of the islands as they now exist, and the phenomena in relation to their rock-structures, superficial soils, and animal exuviæ, I think it must be apparent to the reader that whatever were the conditions as regards the past, he cannot come to any other conclusion than that the dry land known to us as Malta and Gozo must have at one time partaken of far more extended boundaries; indeed, without doing the slightest outrage to the accumulated truths before stated, I will go further, and assert that in the days when the elephants, river-horses, and other animals sojourned on the area, there was an uninterrupted communication between these islands and Europe or Africa, and very probably with both continents, but whether men lived at the same time on the now submerged land, and shared with these animals a like extinction at the epoch of their destruction, or by even different causes, is another question, which awaits the researches of future natural historians. The negative evidence (such as it

is) as regards Malta tends towards the supposition that the lower animals were the sole occupants of the land; but we know enough of such speculations to make us chary to admit the absence of any traces of his existence as proofs that he was not contemporary with them. The discoveries of late years of human implements, associated with the exuviæ of extinct animals, in Sicily, furnish very strong presumptive proof that he existed on that island in a savage state, when Africa and Sicily were united by dry land.[1] Indeed, over thirty years ago, Cuvier examined every collection and exhausted the records and traditions of every ancient people in searching for the evidences of man among the oldest quaternary deposits, but in vain; yet, notwithstanding his bias in favour of the modern origin of the human race, he admitted the possibility that man may have lived before the epoch when the greater portion of Europe, Asia, and North America were clad for unreckoned ages in vast mantles of ice and snow, thus shadowing forth the proofs which subsequent events are tending to establish. The present known evidence, therefore, of the above stage in the far back history of the Maltese islands is *nil;* nor, I regret to say, more happy are the researches of the antiquarian as to even civilized man's first appearance on the present scene. Who were the first

[1] With reference to the latter island, we have it recorded among the always cautious and well-considered deductions of the sagacious natural observer to whose researches I have frequently alluded in the preceding pages, in descanting on the human implements and fossil remains of extinct animals discovered by him in the famous Grotta di Maccagnone in the basin of Palermo, he came to the conclusion that there was strong presumptive proof, "that the date of man's occupation, in the savage state, of Sicily went back to a period extremely remote as compared with accepted chronology, Biblical or profane, when the Mediterranean was bridged over by land connecting Sicily with Africa as a promontory of that continent."—*Primeval Man and his Contemporaries*—Falconer, *Pal. Mem.*, vol. ii. p. 596.

human inhabitants of the islands? from whence did they come? what was their subsequent history up to recorded times? These questions, for the present at all events, in the greater part remain unsolved; for although I have furnished the reader with what may be called faint glimmerings of the history of the islands up to a comparatively speaking recent geological period, yet how far distant this epoch may be in man's computation, and how remote from where the geologist ends and the archæologist commences, we cannot at present even surmise.

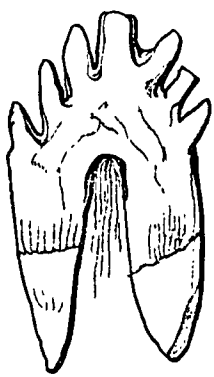
It is apparent, therefore, that their physical history from first to last is like a chain broken in many places, with here and there a link wanting, whilst still greater gaps present themselves and make us almost despair of being ever able to restore them. Nevertheless we can always fall back on the broad facts, and bide our time when more extended researches shall enable us to interpret them with greater accuracy, and establish an harmonious fabric, where disjointed and diverse data before existed. "In an age of such rapid and brilliant progress as the present," remarks the great Humboldt, "it is a sure criterion of the numbers and value of the discoveries to be hoped for in any particular science, if though studied with great assiduity and sagacity, its facts still appear for the most part unconnected, with little mutual relation, or even in some instances in seeming contradiction to each other."

LIST OF FOSSIL REMAINS DISCOVERED IN THE MIOCENE STRATA OF THE MALTESE ISLANDS.

*The Roman numbers indicate the beds where the species have been found. * shows the animal is rare in the formations.*

MAMMALIA.

Tapiroid amphibian, v.* (1.)
Zeuglodon *cetoïdes?* IV.* (2.)



Tooth of Zeuglodon (½ *Nat. Size*).

Halitherium, IV.* (3.)
Dugong (2 sp.), II. IV. (4.)
Menatee, II. IV. (4.)
Phoca rugosidens, IV.* (5.)
Dolphin, II. IV. (6.)
Whales sp.? II. III. IV. V. (7.)

REPTILIA.

Crocodilians sp.? IV. (Gavialis). (8.)

PISCES.

Stereodon melitensis, IV.* (9.)
Myliobates toliapicus, II. III. V. (10.)
Myliobates sp.? III. IV.
Otobates subconvexus, II. III. (11.)
Notidanus primigenius, IV.* (12.)
Platax woodwardii, IV.*
Diodon sp.? I. IV. V. (13.)
Sphærodus gigas? II. V. (14.)
Sphærodus sp.? I. III. IV. V.
Sphenodus, IV.
Carcharodon megalodon, II. III. IV. V. (15.)
Carcharias productus, II. III. IV. V.
Oxyrhina xiphodon, II. IV.
Oxyrhina hastilis, II. IV.
Oxyrhina mantelli? II.
Hemipristis serra, II. IV.
Hemipristis paucidens, II. IV.
Corax aduncus, II.
Odontaspis hopei? III. IV.

(*Many of the shells, especially bivalves, are met with only in form of casts, and consequently difficult to determine with accuracy; the latter are printed in italics.*)

MOLLUSCA.

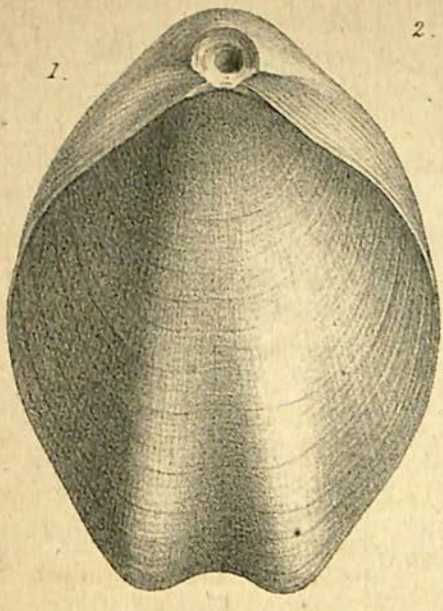
Terebratula sinuosa, I. II. III. IV. (16.) Plate X. fig. 1.
Terebratula minor, IV. Fig. 2.
Terebratula caput serpentis, IV. Fig. 3.
Megerlia truncata, I. II. Fig. 4.
Argiope decollata, I. Fig. 5.
Thecidium adamsi, IV. V. Fig. 6.
Rhynchonella bipartita, I. Fig. 7.
Waldheimia garibaldiana.
Ostrea boblayei, I. II. IV. V.
Ostrea virleti, II. IV.
Ostrea navicularis, II. V.
Pecten pandora, I. II. III. (17.)
Pecten cristatus, IV. V.
Pecten burdigalensis, I. II. III.
Pecten beaudanti, I.
Pecten scabrellus, I. IV.
Pecten squamulosus, II. IV. V.
Pecten varius, I. II. III. V.
Pecten (sp. 3 or 4 ?), I. to V.

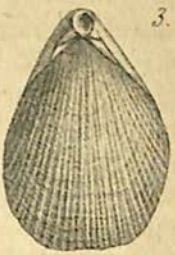
N.B.—*The pectens have not been critically examined.*

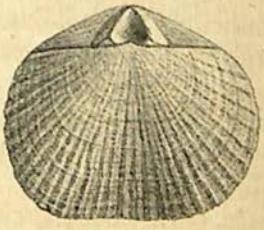
Spondylus quinque costatus, I. V.
Spondylus sp. 1 ? IV.* (18.)
Isocardia, I. II. IV. V.
Arca, I. V.
Tellina, II.
Lucina, 2 sp. ? III.
Cytherea, I.
Venus, I. V.
Cardita, III.
Clavagella, IV.
Thracia, I.
Pinna, I.
Anomia, II. III. IV.
Chama, I.*
Cyclas, I.
Pholas (sp. 2 to 4 ?), I. to V. (casts mostly).
Lithodomus, V.
Teredo, 2 sp. V. (19.)
Rostellaria, III.
Pyrula, II.
Fusus, V.
Doleum, IV.
Columbella, I. III.
Olivea, I. II. IV. V.
Conus (2 to 3 sp. ?), I. to V. (sometimes casts only).
Pleurotoma, II. III. IV. V.
Voluta, I. to V.
Cypræa, II.
Natica, II. III. IV.
Turritella, I. II. IV.
Scalaria ducei, IV. V.
Scalaria retusa, IV.
Scalaria swanni (mihi), IV. (20.) Fig. 9.
Scalaria (sp. 1 ?), III.
Solarium, I. to IV.
Phorus, II.
Turbo, II.
Trochus, I. to IV.
Rotella (?), I.
Haliotis (sp. 2 to ?), I. V. (21.)
Patella, V.
Dentalium (sp. many), IV.
Mitra, III. V.
Vaginella depressa, IV.
Hyalea, IV.
Sepia (2 or more sp.), III. IV. (mucro. only).
Nautilus zic-zac, III. IV. (22.)
Nautilus (2 to 3 sp. ?), IV.

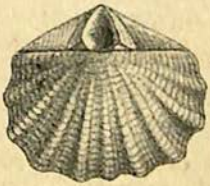
CRUSTACEA.

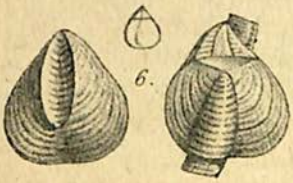
Macrourous crustacea, fragments of many sp. belonging to genera *macrophthalma*, *hella*, *etc.*, are plentiful throughout all the beds.

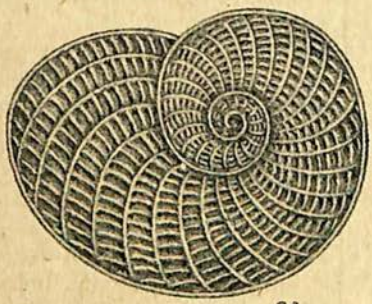












W.H.M.c Farlane, Lith.r Edin.r

FOSSIL SHELLS.

1. Terebratula sinuosa. 2. Terebratula minor. 3. Terebratula caput-serpentis.
4. Megerlia truncata. 5. Argiope decollata. 6. Thecidium Adamsi (nat. size & magn.d)
7. Rhynchonella bipartita. 8. Heterostegina depressa (nat. size & much magnified)
9. Scalaria Swanni.

Tubicolar annelides are plentiful in I. and V.

Serpulæ attached to shells and echinæ are frequent in No. I. A. balanus, not apparently distinct from B. stellaris, is common in Nos. I. and IV., besides another species in the clay. The genus lepas is also represented in No. IV.

Heterostegina depressa, I. to V. (23.) Plate X. fig. 8 and 8ª.

ECHINODERMATA.

(*Nearly all the echinæ named in this list are described in Annal. and Mag. Nat. Hist.*, vol. XV., and *Proc. Geol. Soc. Lond.*, vol. XX. p. 470.)

Cidaris melitensis, I. II. V. (24.) Plate XII. fig. 1.

Cidaris scillæ, I. IV.

Cidaris adamsi, V. Pl. XII. fig. 2.

Cidaris (sp. ?), IV.

Psammechinus duciei, I. IV. V. (25.)

Psammechinus scillæ, I. (26.)

Clypeaster altus, I. II. (27.)

Clypeaster tauricus, I.

Clypeaster marginatus, I. II.

Clypeaster reidii, I.*

Clypeaster umbrella, I.* (28.)

Clypeaster portentosus, II.

Clypeaster latirostris, V.

Clypeaster folium, IV. (29.)

Clypeaster rosaceus. (30.)

Scutella subrotunda, V.

Var. striatula, V.

Pygorhynchus vassali, IV.*

Pygorhynchus spratti, IV.* Plate XI. fig. 3.

Echinolampas hayesianus, I. II. (IV. ?) (31.)

Echinolampas laurillardi, I. III. IV. (32.)

Echinolampas hemisphericus, I.

Echinolampas scutiformis, V. Plate XI. fig. 7.

Echinolampas kleinii, I. IV. V. (33.)

Amblypygus melitensis, I.

Conoclypus plagiosomus, II. IV. (34.)

Hemiaster cotteaui (I. ?), IV. V.

Hemiaster scillæ, III. IV. V.

Brissopsis duciei, I.

Brissopsis grateloupi, IV. V.

Schizaster scillæ, I. II. IV. V. (35.) Plate XI. fig. 6.

Schizaster parkinsonii, I. IV. V. (36.)

Schizaster desori, IV. (37.)

Pericosmus latus, IV. V.*

Toxobrissus crescenticus, I. IV. V. (38.)

Prenaster excentricus, I.

Brissus latus, I.*

Brissus cylindricus, I. II. V.

Brissus imbricatus, I.*

Brissus tuberculatus, I.

Brissus oblongus, I. V. (39.) Plate XI. fig. 5.

Eupatagus koninckii, I. II. IV. V. (40.) Plate XI. fig. 8.

Spatangus ocellatus, IV. V. (41.) Plate XI. fig. 4.

Spatangus delphinus, I. II. IV. V. (42.)

Spatangus pustulosus, IV.

Detached *ossicula* of starfishes are very common along with the above throughout all the beds, more especially in the

nodule seams of the calcareous sandstone, and from their dimensions seem to represent a great variety of species.

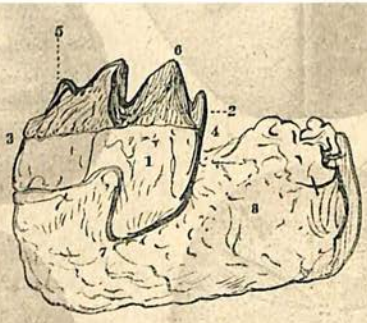
PROTOZOA.

Amplexus cornu bovis, IV.
Flabellum (sp. many), I. III.
Fungidæ, III. Zoanthariæ, IV.
Isis melitensis, IV.
Caryophylla, III.
Eschara monilefera, I.
Cellepora mamillata, II. III.
Clionia, I. IV. V.
Orbitoides dispansus, V.

Nodosaria raphanus,
Nodosaria raphanistrum,
Nodosaria radicula,
Dentalina acicula,
Dentalina pauperata,
Lingulina costata,
Frondicularia annularis,
} Common in No. IV., generally distributed.
Cristellaria calcar, IV.
Planorbulina anumonides, II.
Globigerina bulloides, II.
Truncatulina lobatula, II.
Calcarina rarispina, II.
Corallines, I. to V.
Shapes of sea-weeds.
Retepores of various species.

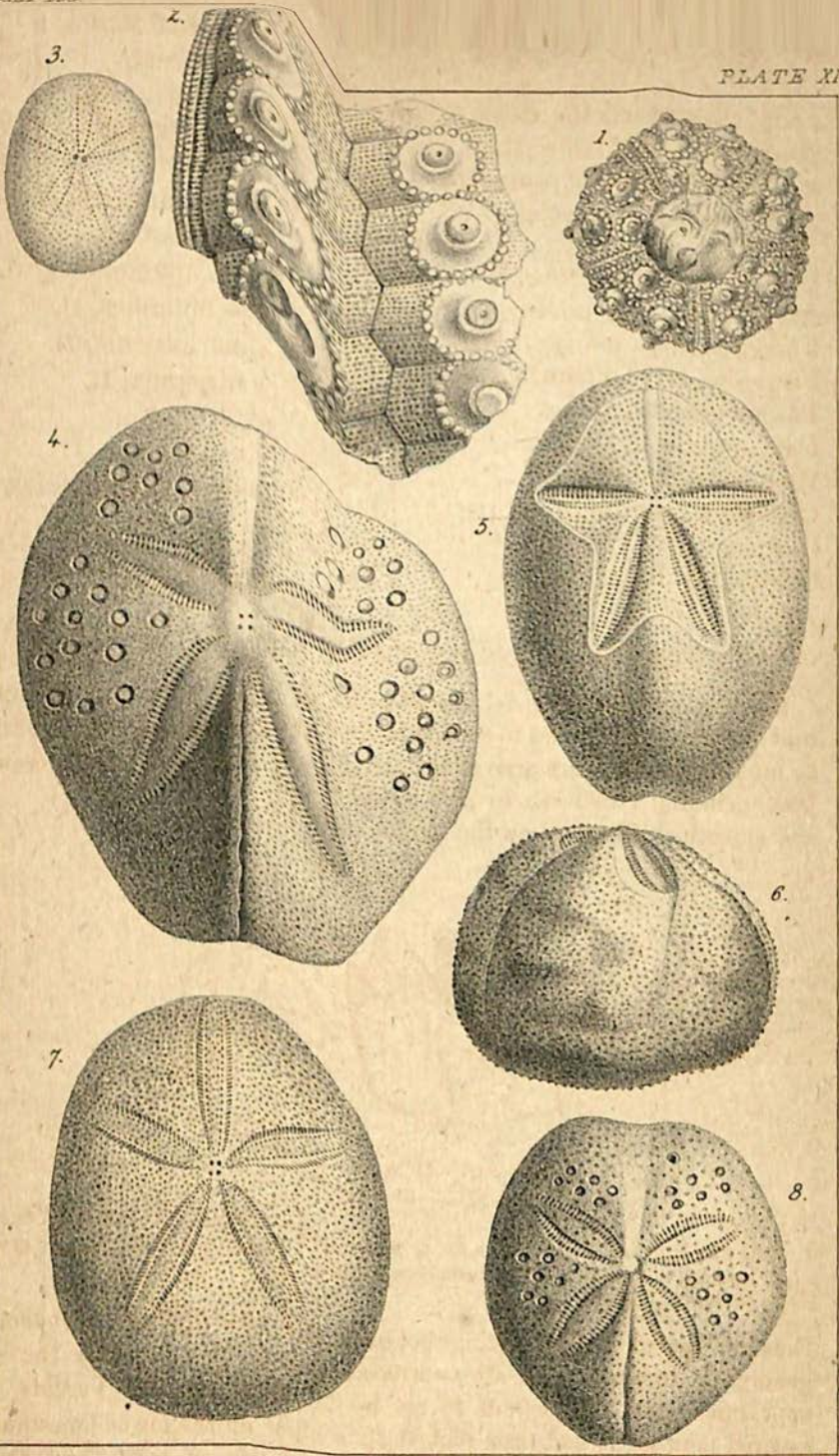
OBSERVATIONS ON THE MIOCENE FOSSILS.

(1.) A very interesting relic, said to have been found in Gozo (but the best of my inquiries failed to trace it beyond its owner in Valetta), was shown to me shortly after my arrival in Malta. It was a portion of the upper jaw, including two teeth in position, showing the oblique linear polished and smoothed attritions on the hinder sides of the ridges of the crowns,



1. Fang deeply embedded in matrix 8. 2. Posterior lobe partially broken. 5. A deep pit depression; from 3 to 4 equals $\frac{3}{4}$ of an inch. From 6 to 7, $1\frac{1}{4}$ inches; greatest thickness $1\frac{3}{10}$ inches.

thus indicating a close fitting between the two opposing grinders, so general in tapirs. Soon afterwards another tooth of exactly the same appearance was kindly lent to me by M. Zant, of Citta Vecchia, who assured me that it had been picked off a shelf of the lower limestone by a fisherman when descending the southern cliffs opposite Casal Dingli.



W.H.M.c Farlane, Lith.r Edin.r

FOSSIL URCHINS.

1. Cidaris Melitensis. 2. Cidaris Adamsi. 3. Pygorhynchus Spratti.
4. Spatangus ocellatus 5. Brissus oblongus. 6. Hemiaster Scillæ.
7. Echinolampas scutiformis 8. Eupatagus Koninckii.

It was embedded in a piece of soft porous limestone, almost of the consistence of stalagmite. Compared with the extinct tapiroid pachyderms, it was apparent therefore that both specimens had certain characters in common with the genus lophiodon, or ridge-toothed quadrupeds, with which Cuvier's researches among the eocene formations of France have made his name famous. The figure opposite represents an outside view of the molar in M. Zant's possession, with the dimensions.

Like the other, this tooth was a deep brown, the dentine compact and glistening. Thus, being three-lobed, with trenchant ridges, it stands to be a last (probably lower) molar of a species of cetacean allied to the dugongs, menatees, and other amphibian mammals of the miocene epoch; affording another proof of the proximity of land during the period of the deposition of the beds.

I do not find that the specimens have any close similarity to the allied form Halitherium; and in the absence of direct proofs of the finding of the above specimens in Maltese rocks, I must leave the subject of their discovery for the present an open question, in hopes that further inquiries may elicit additional disclosures of these interesting remains.

(2.) The Sicilian painter Scilla, in 1670, figured in his *De Corporibus Marinus*, tab. XII. fig. 1, a fragment of jaw, with teeth, which seems to be the only specimen of this great extinct carnivorous whale that has turned up in Maltese strata. From the drawing, I imagine the matrix to be the calcareous sandstone, where cetaceous vertebræ of very large size are met with, chiefly in the third nodule seam. One especially, from the black-grained sand of Chelmus, Gozo, measured one foot in length by fourteen inches in breadth, and may have belonged to this cetacean, which, according to the numerous remains found in the miocene of Alabama, U.S., would represent the usual length of the monster to have been about seventy feet. So plentiful were its bones in the latter country, that they were used by the farmers for making walls, or were burned to rid the fields of them (Dana's *Manual of Geology*, p. 515).

(3.) I have figured a penultimate molar of this very remarkable extinct amphibious mammal in *Proc. of Geol. Society of London*, vol. xxii. p. 595, which, along with an ear-bone and caudal vertebra of possibly the same animal, were discovered by me in No. II. and third nodule seam of No. IV. Like the dugong and menatee, the halitherium lived near the coast-mouths of rivers.

(4.) The dugong and menatee have left their bones and teeth in the sand-bed especially, where the tusks of the former are not uncommon.

(5.) The teeth of a nondescript seal, with rough and serrated margins, were discovered in No. IV., near the village of Xeuchia, in Gozo, and has been named *P. rugosidens* by Professor Owen.

(6.) Jaws, with teeth evidently of more than one species, are met with in Nos. II. and IV., as demonstrated by the form, size, and arrangement of the latter.

(7.) Large-sized vertebræ of whales of undeterminable species are common in all, excepting the lower limestone. Large portions of jaw-bones are found occasionally.

(8.) Jaws, teeth, and bones of gavial-like crocodilians of large dimensions are not rare in No. IV. bed. I found a vertebra of what I supposed belonged to this reptilian form, exceeding the dimensions of the recent *Gavialis gangeticus*, which is the only representative of what was an extensive genus of procœlian crocodilians during the eocene and miocene periods.

(9.) Described by Professor Owen in the *Geological Magazine*, 1864.

(10.) A perfect set of teeth from No. II., and a fragment of the teeth of evidently the same species of skate from No. V. bed, was carefully compared with *M. toliapicus* (Ag.), and found to agree in every particular. Spines of large size are not rare in No. III.

(11.) *O. subconvexus* (Ag.) is represented by specimens from No. II., a very perfect one of which is in the Museum of the Public Library, Valetta. I have seen fragments of what appeared to be this ray from the clay bed, where its genus seems to have been very common. No doubt a diligent search will disclose many rays, more especially in beds II. and III.

(12.) I have admitted this shark among the Maltese fossil fauna solely on the authority of Scilla, who figures a specimen in his work referred to, and states it was found in Malta.

(13.) This genus is evidently represented in No. I. by one or more small species, and in No. V. much larger pavement-shaped teeth indicate the presence of very large globe-fishes in the seas of the period.

(14.) This species seems well represented by numerous specimens from No. II., at least the teeth equal in size *S. gigas* of Pictet, *Trait de Paleontologie*, Pl. xxxvi. fig. 18, 19, whilst smaller specimens are met with in all excepting the sand-bed. Certain impressions and the caudal extremity of a fish (in No. IV.), latter portion composed of cartilaginous rays, represent in all probability (from their shape) this or an allied genus.

(15.) See observations on this and other species of sharks at page 140.

(16.) The *Annal. and Mag. of Nat. Hist.*, 3d series, vol. xiv. p. 1, and Longman's *Geol. Mag.* for July 1864, contain the descriptions and stratagraphical distribution of the species of brachiopods here mentioned. I admit *Waldheimia garibaldiana* altogether on the authority of Mr. Etheridge—*Geologist*, Dec. 1862, Pl. xxiv. fig. 19.

(17.) The three first-named scallop shells are the most common, whilst the genus generally is extensively represented both by species and numbers throughout the entire series.

(18.) A spondylus, very distinct from *quinque costatus*, is met with in the sandstone around Fort Tigne.

(19.) Specimens of a large species are abundant on the sides of the Macluba pit, and in the gorge of Maggiar Scini.

(20.) Named after my friend Captain Swann, F.G.S., who first directed my attention to the specific distinctions between it and *S. ducei*, viz., in the greater number of transverse plaits, and fewer number of longitudinal striæ, together with more slender outlines of the shell; these characters are regular, and not apparent in any other described species.

(21.) Casts of a very characteristic ear-shell are extremely common in the upper portions of No. I. bed.

(22.) This very characteristic nautilus is almost characteristic of the marl-bed. A few specimens, however, are met with in the calcareous sandstone. Many perfect casts sent to the late Mr. S. P. Woodward were carefully compared by him with the London clay nautilus of the same name, and he informed me that, as far as the casts went, he could not discover any differences between the two.

(23.) Some idea of the contributions made by foraminiferous mollusks towards the formation of sea-bottoms, can be gathered from inspections of many of the cliffs of the sand-bed in various parts of the islands, where the rocks seem almost entirely formed of the shells of this species; and in some situations, as, for example, at the upper part of No. V., they will be found much larger than the species met with generally in No. II., although on minute examination no further distinctions are seemingly apparent; but as there are evidently two distinct sorts as regards dimensions, and frequently associated, I do not think I shall be doing violence to the canons of nomenclature by naming the largest *Heterostegina stricklandi*, in memory of Captain Strickland, R.N., for whose friendship and solicitous concern in my natural-history pursuits I shall always retain a grateful remembrance.

(24.) I have frequently found *C. melitensis*, with its spines attached; they are round, very much longer than the test, and sculptured. The spines of *C. scillæ* and *C. adamsi* are met with about five inches in length, with extremities bifurcate or umbrella-like. This fine urchin is found in the upper part of No. V., to eastward of Fort Ricasoli, but I have never got it entire. There are spines and fragments of tests differing from any of the allied species, thus indicating that further researches in this and the overlying bed are likely to discover several new forms of the genus

cidaris, besides what are here enumerated. The *C. scillæ* is also met with in fragments.

(25.) This is the *Echinus duciei* of Dr. Wright's monograph, *Annal. and Mag. Nat. Hist.*, vol. xv. p. 8. It is very common in the same situations as the *C. adamsi*. I have found specimens with an antero-posterior diameter over the dome of $4\frac{4}{10}$ inches; tranverse at base $3\frac{1}{10}$ in.; height $1\frac{8}{10}$.

(26.) *P. scilla*, on which Dr. Wright founds specific distinctions, is seemingly very closely allied to *P. duciei*. If I mistake not, Scilla's echinus was procured in Messina; indeed, as far as Scilla's picture is concerned, it would be difficult to say whether or not it illustrates the one or other species.

(27.) This common Maltese urchin presents much variety in dimensions and outline. The cone-shaped is the most common, but sub-conical, campanulate, tumid, and flattened tests are plentiful, the last usually in No. I. Individuals attain large dimensions,—for example, one procured from No. II. was $7\frac{1}{2}$ inches long, 7 inches broad, and 6 inches in height. Many sorts would agree with *C. crassicostatus*, which, after all, may be only worn specimens of *altus*.

(28.) *C. umbrella* and *reidii* are similar, but they are distinguishable in outline, and also in the shape and size of the ambulacrum, which is much larger and narrower in reidii than in umbrella.

(29.) This clypeaster is very like a small variety of *C. marginatus*, which, however, has not been found in No. IV. The former is not uncommon in the nodule seams, where it usually attains an antero-posterior diameter of $3\frac{2}{10}$ inches and breadth of 3 inches; height about $\frac{8}{10}$ inches.

(30.) One specimen in the Public Library agrees closely with *C. rosaceus* of Lamarck, if this be a good species.

(31.) This the *E. deshayesii* of Desor and Wright's monograph (*op. cit.*).

(32.) *E. richardi* of Desmarest.

(33.) Not uncommon in No. I., less plentiful in the other beds.

(34.) Portions of this urchin are seen strewing the sandstone No. IV. at Blat-el-Kinci, Gozo. Its head-quarters, however, are in the sand-bed.

(35.) This is the *S. eurynotus* of Agassiz, and one of the most common urchins, especially in No. I. It is indeed rare in No. IV., and small in V.

(36.) This is one of the most common of all the echinæ abounding in No. IV.

(37.) Good specimens may be obtained in No. IV. on the south side of Mellcha Bay.

(38.) This urchin is not uncommon in the transition bed of No. v. east of Ricasoli. It is the *Brissopsis crescenticus*, figured and described by Wright, *Annal. and Mag. Nat. Hist.*, vol. xv., Pl. vi. fig. 2 *a-c*.

(39.) Is extremely common in many parts of No. i. on the southern coast of Malta, where it is associated with *Prenaster excentricus*, which is also not rare.

(40.) Named in the first instance by Dr. Wright (*op. cit.*), *Spatangus de koninckii*.

(41.) This fine and very characteristic urchin is not common. I procured, however, some good specimens in the lower limestone on the south-west coast of Gozo. It is the *S. hoffmanni* of Dr. Wright's monograph, *Annal. and Mag. Nat. Hist.*, vol. xv.

(42.) This is the *S. desmarestii* of Wright's monograph, *Annal. and Mag. Nat. Hist.*, vol. xv.

Specimens procured by me equal if not exceed the German types in dimensions, as may be verified by collecting them in the pale variety of No. iv. on the cliffs of Marsa Sirocco.

FISHES OF MALTA.

THE following list is given on the authority of Dr. Gavina Gulia, and as enumerated in his *Tantamen Ichthyologie Melitensis* (Valetta, 1861). Whilst making no pretence to completeness it may be safely accepted as a truthful report on the general ichthyology of the locality, inasmuch as Dr. Gulia has devoted many years to the especial study of the fishes of his native islands, and enjoyed unusual opportunities for obtaining specimens from the fishermen and in the markets. The latter are among the chief zoological attractions, more particularly early in the day, when the stalls present a great variety, both as to numbers and species, many of which, including the famous tunny and the *lampucca* or coryphane (dolphin of the ancients), are famous either as articles of food, or for their brilliant and beautiful colourings. The local names will facilitate the student in obtaining specimens; for further particulars the reader will find Dr. Gulia's brochure extremely useful.

An asterisk indicates that the fish is rare in the locality.

	Native name.
*Petromyzon marinus (Linn. 1551),	*Kalfat.*
Muræna hælena (Linn. 1132),	*Morina.*
Muræna unicolor (Del. 191),	*Morina.*
Anguilla vulgaris (Kaup),	*Sallura.*
Conger niger (Risso, 201),	*Gringu ta barra.*
Conger verus (Risso, 201),	*Gringu tal port.*
Conger balearicus (Del.),	*Serp.*
Clupea argyrochlora (Cocco),	*Sardina.*
Clupea chrysotænia (Cocco),	*Sardina.*

	Native name.
Clupea sardina (Rosso, 45).	
Alosa communis (Cuvier), . .	*Lacci.*
Clupanodon phalerica (Rosso, 452).	
Engraulis enchrasicolus (Cuv.), .	*Inciova.*
Engraulis desmaresti (Risso, l. c.), .	*Nemusa.*
Engraulis amara (Risso, l. c.), . .	*Nemusa.*
Saurus lacerta (Risso, 473), . .	*Scalm.*
Micromugil timidus (Gulia), . .	*Buzak.*
Micromugil macrogastei (Gulia), .	*Buzak.*
Scomberesox camperii (Lac. v. vi.), .	*Castardella.*
Exocætus exiliens (Bloch, 397), .	*Rondinella.*
Belone acus (Risso, 443), . .	*Imsella.*
Syphræna spet (Lacep.) . .	*Litz.*
Tetrapturus belone (Refin. Caratt. pl. 1),	*Imsella imperiala.*
Chromis castanea (Cuv. 203), . .	*Caula.*
Crenilabrus zerephinus (Gulia).	
Crenilabrus schembrianus (Gulia).	
Crenilabrus dubius (Gulia).	
Crenilabrus ocellatus (Rosso), . .	*Tirda.*
Crenilabrus serranus (Gulia), . .	*Tirda.*
Crenilabrus chrysophorus (Risso), .	*Boxbox.*
Crenilabrus roissali (Risso), . .	*Boxbox.*
Crenilabrus serranoides (Gulia).	
Crenilabrus intermedius (Gulia).	
Crenilabrus geoffroi (Risso), . .	*Boxbox.*
Crenilabrus locaninus (Gulia).	
Crenilabrus brunnichii (Lacep. 3, 124).	
Crenilabrus propinquus (Gulia).	
Labrus festivus (Risso, 304), . .	*Boxbox.*
Labrus merula (Risso, 306), . .	*Mirli.*
Labrus mistus (Lin. 1297), . .	*Parpaniol.*
Labrus turdus (Rond. 1549), . .	*Tirda.*
Labrus carneus (Bloch.), . .	*Bagnal.*
Julis vulgaris (Cloquet), . .	*Gharusa.*
Julis giofredi (Risso, 310), . .	*Gharusa.*
Julis turcica (Rosso, 312), . .	*Lghundi.*
Coricus virescens (Cuv. 263), . .	*Buxih ahdar.*
Ctenolabrus iris (Val. His. des., p.), .	*Debba.*
Xyrichthys novacula (Cuv. 2, 206), .	*Busetta.*
Scarus creticus (Aeld.), . .	*Martzpan.*
Ophidium barbatum (Lin.), . .	*Ballottra ta Ramel.*
Merluccius esculentus (Risso, 220), .	*Marloz.*

	Native name.
Phycis mediterranea (Bonap.).	
Phycis tinca (Schu.), . . .	*Lipp.*
Motella mustella (Bon.), . .	*Ballottra.*
Echeinis remora (Lin.), . .	*Piscitmum.*
Rhombus lævis (Rond.), . .	*Barbun.*
*Rhombus maximus (Cuv.), . .	*Linguata.*
Solea vulgaris (Cuv.).	
*Solea monochin (Bon.).	
Trachinus draco (Lin.), . .	*Tracna.*
Trachinus lineatus (Risso, 260), .	*Saut.*
Uranascopus scaber (Lin.), . .	*Zondu.*
Labrax lupus (Cuv.), . . .	*Spnotta.*
Apogon rex mullorum (Cuv.), . .	*Saltan el ciaul.*
Serranus scriba (Cuv.), . .	*Burkax.*
Serranus cabrilla (Cuv.), . .	*Sirran.*
Serranus hepatus (Cuv.), . .	*Hanzir.*
Anthus sacer (Bloch.), . .	*Pisci rosa.*
Cerna gigas (Bonap.), . . .	*Cerna.*
Polyprion cernium (Val.), . .	*Hanzir.*
Mullus barbatus (Lin.), . .	*Triglia.*
Mullus surmuletus (Lin.), . .	*Triglia.*
Trigla corax (Bonap.), . . .	*Galinetta.*
Trigla lyra (Lin.), . . .	*Ghadma.*
Trigla cuculus (Lin.), . . .	*Zombrell.*
Trigla lineata (Bon.), . . .	*Galinetta.*
Peristedion cataphractum (Lac.), .	*Pixi cornutu.*
Dactylopterus volitans (Lacep.), .	*Falcun o, bies.*
Scoropæna scropha (Lin.), . .	*Ceppullazza.*
Scoropæna porcus (Lin.), . .	*Scorfna.*
Sebastes imperialis (Cuv.).	
Hoplostethus mediterranea (Cuv.).	
Gasterosteus aculeatus (Lin.).	
Umbrina cirrhosa (Cuv.), . . .	*Gurbell.*
Sargus salviani (Cuv.), . .	*Xirghien.*
Sargus rondoletii (Cuv.), . .	*Sargu.*
Sargus annularis (Cuv.), . .	*Sparlu.*
Charanx puntazzo (Cuv.), . .	*Moghza.*
Pagrus vulgaris (Cuv.), . .	*Pagru.*
Pagrus orphus (Cuv.), . . .	*Hauat.*
Pagellus mormyrus (Cuv. 7, 97), .	*Mingus.*
Pagellus acarne (Cuv.), . .	*Bazuga.*
Pagellus bogaraveo (Gm.), . .	*Bazuga.*

	Native name.
Pagellus centrodonotus (Cuv.).	
Pagellus erthyrinus (Cuv.),	*Pagell.*
Dentex vulgaris (Cuv.),	*Dendici.*
Boops vulgaris (Cuv.),	*Vopa.*
Boops salpa (Cuv.),	*Minuta tartarella.*
Cantharus orbicularis (Cuv.),	*Tannuta.*
Oblada melanura (Cuv.),	*Cahlia.*
Chrysophrys aurata (Cuv.),	*Aurata.*
Smaris chryselis (Cuv.),	*Arznell.*
Mæna vomerina (Cuv.),	*Arznella bastarda.*
Mæna osbekii (Cuv.).	
Atherina hepesetus (Lin.),	*Curunella.*
Atherina boyeri (Risso),	*Curunella.*
Mugil cephalus (Bonap.),	*Caplat.*
Mugil chelo (Cuv.),	*Mulet.*
Mugil labeo (Cuv.),	*Bobin.*
Mugil capito (Cuv.),	*Mulett ta limciarrat.*
Mugil auratus (Risso, 390),	*Mulett ta ciarruta safra.*
Mugil saliens (Risso, 391),	*Buri.*
Naucrates ductor (Cuv.),	*Famfru.*
Naucrates fanfanus (Raf.),	*Famfru.*
Lechia vadigo (Cuv.),	*Sirra.*
Centronotus glaucus (Risso),	*Stillera.*
Mycropterix dumereilii (Agassiz),	*Acciola (dum parva ceriola).*
Caraux trachurus (Cuv.),	*Saurella.*
Caraux luna (Cocco),	Saurella imperiala.
Coryphæna hyppurus (Lin.),	Lampuca.
Coryphæna pelagica (Bon.),	Lampuca.
Scomber scombrus (Lin.),	Caval.
Scomber pneumatophorus (Dela.).	
Scomber colias (Lin.),	Pizzintum.
Auxis bison (Bon.),	*Sgamirru.*
Thynnus mediterraneas (Cuv.),	*Tonn.*
Thynnus allitteratus (Gulia),	*Cubrit.*
Thynnus brevi-pennis (Cuv.),	*Tombrell.*
Thynnus alalonga (Cuv.),	*Alonga.*
Pelamys sarda (Cuv.),	*Palamit.*
Xiphias gladius (Lin.),	*Piscispat.*
Zeus faber (Lin.),	*Pisci-san-Pietru Moxt.*

	Native name.
Capros aper (Lin.),	*Pisci trumbetta.*
Cepola rubescens (Lin.).	*Fiamma.*
Gymnetrus cepedianus (Risso),	*Fiamma.*
Centriscus scolopax (Lin.),	*Beccaccia.*
*Lepadogaster decandolli (Risso),	*Buahhal.*
*Callyonimus admirabilis (Risso),	*Uizgha tal bahar.*
Gobius cruentatus (Lin.),	
Gobius niger (Lin.),	
Gobius bicolor (Lin.),	*Mazzun.*
Gobius paganellus (Lin.),	
Gobius guttatus (Risso),	
Gobius jozzo (Lin.),	
Aphia meridionalis (Risso),	*Maccu.*
Blennius gattorugine (Lin.),	*Budaccra.*
Blennius ocellaris (Lin.),	*Budaccra tal ghain*
Ichthyocoris pavo (Bon.).	
Pholis lævis (Val.),	*Bazullieka.*
Trypterygion nasus (Risso).	
Clinus argentatus (Risso).	
Lophius piscatorius (Lin.),	*Petricia.*
Lophius budegassa (Spiriola),	*Petricia.*
Orthogoriscus mola (Lin.),	*Pisci luna o, Kamar.*
Lagocephalus pennanti (Swan.),	*Hmar.*
Hippocampus brevirostus,	*Ziemel tal bahar.*
Hippocampus guttulatus (Cuv.),	*Ziemel tal bahar.*
Sygnatus tiphle (Lin.),	*Dremxula, tal bahar.*
Scyllium canicula (Cuv.),	*Gattarell.*
Scyllium stellare (Bon.),	*Gattarell ta ruccal.*
Scyllium melanostomum (Bon.),	*Gattarell.*
Galeus canis (Rond.),	*Mazzola ta bla xeuca.*
Galeus glaucus,	*Kelb el bahar.*
*Carcharodon lamia (Bon.),	*Silfun.*
*Odontaspis ferox (Ag.).	
Lamna cornubica (Bon.).	
Alopecias vulpes (Müh.).	
Notidanus griseus (Bon.),	*Murruna.*
Notidanus cinereus (Bon.),	*Murruna.*
Spinax acanthias (Clo.),	*Mazzola bix zeuca.*
Spinax vulgaris (Risso).	
Centrina salviani (Risso),	*Giurdien tal bahar.*
Echinorhinus spinosus (Blain.).	
Squatina angelus (Dum.).	

	Native name.
Squatina ocellata (Bon.).	
Zygæna malleus (Cuv.), . .	*Curatza.*
Pristis antiquorum (Lath.), . .	*Sia.*
Torpedo narce (Bon.), . . .	*Haddiela.*
Torpedo galvani (Risso), . .	*Haddiela.*
Raia clavata (Lin.), . . .	*Raia petrusa.*
Raia miraletus (Lin.), . . .	*Raia liscia.*
Raia batis (Bon.), . . .	*Raia tal ramel.*
Læviraia oxyrhyncus (Bon.), . .	*Rebecchin et Violin.*
Trygon pastinaca (Adan), . . .	*Boll.*
Myliobates aquila (Dum.), . .	*Hamiema.*

BIRDS OF MALTA.

*Species marked * are resident; such marked † are accidental arrivals; the remainder are, more or less, regular birds of passage.*

Egyptian vulture,	*Neophron percnopterus.*
Imperial eagle,	*Aquila heliaca.*
Spotted eagle,	*Aquila nævia.*
Osprey,	*Pandion haliaëtus.*
Short-toed eagle,	*Circaëtus gallicus.*
Honey buzzard,	*Pernis apivorus.*
Common kite,	*Milvus regalis.*
Black kite,	*Milvus migrans.*
Marsh harrier,	*Circus æruginosus* (Linn.)
Hen harrier,	*Circus cyaneus.*
Montagu's harrier,	*Circus cineraceus.*
Pale-chested harrier,	*Circus swainsonii* (Smith).
Sparrow-hawk,	*Accipiter nisus.*
Little red-billed hawk,	*Accipiter gabar.*
Goshawk,	*Astur palumbarius.*
Peregrine falcon,	*Falco peregrinus.*
Barbary falcon,	*Falco barbarus.*
Hobby,	*Falco subbuteo.*
Eleonora falcon,	*Falco eleonoræ.*
Merlin,	*Falco lithofalco.*
Orange-legged hobby,	*Falco vespertinus.*
Kestrel,	*Tinnunculus alaudarius.*
Lesser kestrel,	*Tinnunculas cenchris.*
Sparrow-owl,	*Athene noctua.*
Barn-owl,	*Strix flammea.*
Short-eared owl,	*Asio brachyotus.*
Long-eared owl,	*Asio otus.*
Scops owl,	*Scops zorca.*
Wryneck,	*Yunx torquilla.*
Cuckoo,	*Cuculus canor.*

Great-spotted cuckoo,	*Cuculus glandarius.*
Crossbill,	*Loxia curvirostra.*
Bullfinch,	*Pyrrhula vulgaris.*
Vinous grosbeak,	*Pyrrhula githaginea.*
Scarlet grosbeak,	*Pyrrhula erythrina.*
Serin finch,	*Serinus flavescens.*
Hawfinch,	*Coccothraustes vulgaris.*
Greenfinch,	*Chlorospiza chloris.*
Spanish sparrow,	*Passer sallcicola.*
Tree sparrow,	*Passer montanus.*
Rock sparrow,	*Passer petronia.*
Chaffinch,	*Fringilla cœlebs.*
Bramble finch,	*Fringilla montifringilla.*
Goldfinch,	*Carduelis elegans.*
Siskin,	*Carduelis spinus.*
Linnet,	*Linota canabina.*
Cirl bunting,	*Emberiza cirlus.*
Meadow bunting,	*Emberiza cia.*
Ortolan bunting,	*Emberiza hortulana.*
Reed bunting,	*Emberiza schœniclus.*
Common bunting,	*Emberiza miliaria.*
Snow bunting,	*Plectrophanes nivalis.*
Golden-crested regulus,	*Regulus cristatus.*
Fire-crested regulus,[1]	*Regulus ignicapillus.*
Rook,	*Corvus frugilegus.*
Jackdaw,	*Corvus monedula.*
Magpie,	*Pica candata.*
Starling,	*Sturnus vulgaris.*
Sardinian starling,	*Sturnus unicolor.*
Rose-coloured pastor,	*Pastor roseus.*
Common swallow,	*Hirundo rustica.*
Rufous swallow,[2]	*Hirundo daürica.*
House martin,	*Chelidon urbica.*
Sand martin,	*Cotyle riparia.*
Rock swallow,	*Cotyle rupestris.*
Swift,	*Cypselus apus.*

[1] Both the golden-crests seem to come pretty often to Malta, perhaps blown by gales. I have seen the golden-crest there in winter.

[2] This species may turn out to be more common than has been supposed. Most probably individuals come annually from more eastern lands.

White-bellied swift,	*Cypselus melba.*
Nightjar,	*Caprimulgus europœus.*
Rufous-necked goatsucker,	*Caprimulgus ruficollis.*
Spotted flycatcher,	*Muscicapa grisola.*
Pied flycatcher,	*Muscicapa atricapilla.*
White-necked flycatcher,	*Muscicapa abicollis.*
Grey shrike,	*Lanius excubitor.*
Red-backed shrike,	*Lanius collurio.*
Great grey shrike,	*Lanius meridionalis.*
Lesser grey shrike,	*Lanius minor.*
Woodchat shrike,	*Lanius rufus.*
Skylark,	*Alauda arvensis.*
Crested lark,	*Alauda cristata.*
Wood lark,	*Alauda arborea.*
Short-toed lark,	*Alauda brachydactyla.*
Cream-coloured lark,	*Alauda lusitanica.*
Calandra lark,	*Alauda calandra.*
Richard's pipit,	*Anthus richardi.*
Tawny pipit,	*Anthus campestris.*
Meadow pipit,	*Anthus pratensis.*
Red-throated pipit,	*Anthus cervinus.*
Tree pipit,	*Anthus arboreus.*
Water pipit,	*Anthus spinoletta.*
White wagtail,	*Motacilla alba.*
Grey wagtail,	*Motacilla boarula.*
Yellow wagtail,	*Motacilla flava.*
Golden oriole,	*Oriolus galbula.*
Blackbird,	*Turdus merula.*
Ring ouzel,	*Turdus torquatus.*
Song thrush,	*Turdus musicus.*
Missel thrush,	*Turdus viscivoruis.*
Fieldfare,	*Turdus pilaris.*
Redwing,	*Turdus iliacus.*
Rock thrush,	*Petrocincla saxatilis.*
Blue solitary thrush,	*Petrocincla cyanea.*
Wheatear,	*Saxicola œnanthe.*
Russet wheatear,	*Saxicola stapazina.*
Eared wheatear,	*Saxicola aurita.*
Whinchat,	*Saxicola rubetra.*
Stonechat,	*Saxicola rubicola.*
Nightingale,	*Philomela luscinia.*
Redstart,	*Ruticilla phœnicina.*

Blackstart,	*Ruticilla tithys.*
Robin,	*Erithacus rubecula.*
Blue-throated warbler,	*Cyanecula suecica.*
Hedge accentor,	*Accentor modularis.*
Blackcap,	*Sylvia atricapilla.*
Garden warbler,	*Sylvia hortensis.*
Lesser whitethroat,	*Sylvia curruca.*
Orphean warbler,	*Sylvia orphea.*
Whitethroat,	*Sylvia cinerea.*
Subalpine warbler,	*Sylvia passerina.*
Spectacled warbler,	*Sylvia conspicillata.*
Sardinian warbler,	*Sylvia melanocephala.*
Dartford warbler,	*Sylvia provincialis.*
Willow warbler,	*Phyllopneuste trochilus.*
Chiffchaff,	*Phyllopneuste rufa.*
Wood warbler,	*Phyllopneuste sylvicola.*
Bonelli's warbler,	*Phyllopneuste Bonellii.*
Vieillot's warbler,	*Hippolais icterina.*
Rufous sedge warbler,	*Aëdon rubiginosa.*
Great sedge warbler,	*Calamoherpe turdoïdes.*
Reed warbler,	*Calamoherpe arundinacea.*
Savis warbler,	*Cettia luscinoïdes.*
Moustached warbler,[1]	*Cettia melanopogon.*
Sedge warbler,	*Calomodyta phragmitis.*
River warbler,	*Locustella fluviatilis.*
Hoopoe,	*Upupa epops.*
Roller,	*Coracias garrula.*
Bee-eater,	*Merops apiaster.*
Blue-cheeked bee-eater,	*Merops persicus.*
Kingfisher,	*Alcedo ispida.*
Wood pigeon,	*Columba palumbus.*
Stock pigeon,	*Columba œnas.*
Rock pigeon,	*Columba livia.*
Turtle dove,	*Turtur auritus.*
Pintail sandgrouse,	*Pterocles alchata.*
Quail,	*Perdix coturnix.*
Bustard,	*Otis tarda.*
Little bustard,	*Otis tetrax.*
Ruffed bustard,	*Otis houbara.*

[1] I believe the only specimen procured was that shot by me in 1860. wever, it is possible many might annually turn up in the Marsa.

Cream-coloured courser,	*Cursorius europæus.*
Thicknee,	*Ædicnemus crepitans.*
Golden plover,	*Charadrius pluvialis.*
Dotterel,	*Charadrius morinellus.*
Ringed plover,	*Charadrius hiaticula.*
Little ringed plover,	*Charadrius minor.*
Kentish plover,	*Charadrius cantianus.*
Oyster catcher,	*Hæmotopus ostralegus.*
Collared pratincole,	*Pratincola glareola.*
Lapwing,	*Vanellus cristatus.*
Grey plover,	*Vanellus helveticus.*
White-tailed plover,	*Vanellus leucurus.*
Common crane,	*Grus cinerea.*
Numidian crane,	*Anthropoides virgo.*
Common heron,	*Ardea cinerea.*
Purple heron,	*Ardea purpurea.*
White heron,	*Ardea alba.*
Egret,	*Ardea garzetta.*
Squacco heron,	*Ardea comata.*
Buff-backed heron,	*Ardea bubulcus.*
Bittern,	*Botaurus stellaris.*
Little bittern,	*Ardea minuta.*
Night heron,	*Nycticorax europeus.*
White stork,	*Ciconia alba.*
Black stork,	*Ciconia nigra.*
Spoonbill,	*Platalea leucorodia.*
Glossy ibis,	*Ibis falcinellus.*
Curlew,	*Numenius arquatus.*
Whimbrel,	*Numenius phæopus.*
Slender-billed curlew,	*Numenius tenuriostris.*
Black-tailed godwit,	*Limosa ægocephala.*
Bar-tailed godwit,	*Limosa rufa.*
Greenshank,	*Totanus glottis.*
Spotted redshank,	*Totanus fuscus.*
Marsh sandpiper,	*Totanus stagnatilis.*
Redshank,	*Totanus calidris.*
Wood sandpiper,	*Totanus glareola.*
Green sandpiper,	*Totanus ochropus.*
Common sandpiper,	*Totanus hypoleucus.*
Ruff,	*Machetes pugnax.*
Great snipe,	*Scolopax major.*
Common snipe,	*Scolopax gallinago.*

Jack snipe,	*Scolopax gallinula.*
Woodcock,	*Scalopax rusticola.*
Knot,	*Tringa canutus.*
Curlew sandpiper,	*Tringa subarquata.*
Dunlin,	*Tringa cinclus.*
Stint,	*Tringa minuta.*
Temminck's stint,	*Tringa temminckii.*
Sanderling,	*Arenaria calidris.*
Turnstone,	*Strepsilas interpres.*
Stilt,	*Himantopus melanopterus.*
Avocet,	*Recurvirostra avocetta.*
Flamingo,	*Phœnicopterus roseus.*
Water rail,	*Rallus aquaticus.*
Corn crake,	*Crex pratensis.*
Spotted crake,	*Crex porzana.*
Baillon's crake,	*Crex bailloni.*
Little crake,	*Crex pusillus.*
Water hen,	*Gallinula chloropus.*
Coot,	*Fulica atra.*
Crested coot,	*Fulica cristata.*
Skua,	*Stercorarius catarractes.*
Pomarine skua,	*Stercorarius pomarinus.*
Lesser black-backed gull,	*Larus fuscus.*
Herring gull,	*Larus argentatus.*
Audouin's gull,	*Larus audouini.*
Common gull,	*Larus canus.*
Kittiwake gull,	*Larus tridactylus.*
Slender-billed gull,	*Larus gelastes.*
Adriatic or Mediterranean gull,	*Larus melanocephalus.*
Black or brown-headed gull,	*Larus ridibundus.*
Little gull,	*Larus minutus.*
Sandwich tern,	*Sterna cantiaca.*
Common tern,	*Sterna hirundo.*
Lesser tern,	*Sterna minuta.*
Black tern,	*Sterna fissipes.*
White-winged black tern,	*Sterna leucoptera.*
Whiskered tern,	*Sterna hybrida.*
Cinereous shearwater,	*Puffinus cinereus.*
Manx shearwater,	*Puffinus anglorum.*
Stormy petrel,	*Thalassidroma pelagica.*
Cormorant,	*Phalacrocorax carbo.*
Pelican,	*Pelecanus onocrotalus.*

Bean goose,	*Anser segetum.*
Mute swan,	*Cygnus olor.*
Hooper,	*Cygnus ferus.*
Shieldrake,	*Tadorna vulpanser.*
Ruddy shieldrake,	*Tadorna rutila.*
Shoveller,	*Rhynchaspis clypeata.*
Mallard,	*Anas boschas.*
Pintail duck,	*Dafila acuta.*
Gadwall,	*Anas strepera.*
Wigeon,	*Anas penelope.*
Summer teal,	*Anas querquedula.*
Teal,	*Anas crecca.*
Pochard,	*Fuligula ferina.*
Tufted duck,	*Fuligula cristata.*
White-headed duck,	*Fuligula mersa.*
Nyroca duck,	*Fuligula nyroca.*
Red-crested whistling duck,	*Fuligula rufina.*
Red-breasted merganser,	*Mergus serrator.*
Smew,	*Mergus albellus.*
Red-throated diver,	*Colymbus septentrionalis.*
Crested grebe,	*Podiceps cristatus.*
Horned grebe,	*Podiceps cornutus.*
Eared grebe,	*Podiceps auritus.*
Little grebe,	*Prodiceps minor.*
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